THE

NATURAL HISTORY REVIEW.

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AND

QUARTERLY JOURNAL OF SCIENCE.

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INDEX TO REVIEWS, &c.

Page.

ACTINOLOGIA Brittanica. By P. H. Gosse, ... 102
Arctic Explorations in 1853–54–55. By Dr. Kane, ... 119
—— Diary of Mr. D. Walker, Naturalist to the "Fox," 171
—— Ice-Travel, Reminiscences of. By Captain F. L. M'Clintock, ... 34
—— Voyage to Baffin's Bay. By R. A. Goodsir, ... 65
—— Voyage, Letters from Captain M'Clintock, May 6, 1858, ... 170
—— Letter from same, May 7, 1858, ... 165, 169
—— Letter from same, May 24, 1858, ... 168
—— Letters from same, July 12, 1858, ... 182
—— Voyages, the last of. By Sir Edward Belcher, ... 34
Aquarian Naturalist. By T. Rymer Jones, ... 136

Baffin's Bay and Barrow Straits, Journal of a Voyage to. By Dr. Sutherland, . 119
Ball, Robert, LL. D., Memoir of. By Robert Patterson,. 1
Botany, First Lessons in. By Dr. Asa Gray, ... 104
British Flora, Handbook of. By G. Bentham, ... 133

Catalogue of American Works on Natural History, ... 104
—— Invertebrata from the Southern Pacific. By W. Stimpson, ... 105

Diary, Arctic, of Mr. D. Walker, of the "Fox," 171

Eventful History of the "Resolute." By G. F. M'Dougall, ... 119

Foraminifera, on recent British. By W. C. Williamson, ... 156
Franklin Expedition, Renewal of the Search for. By C. Markham, ... 34
—— Lady, Letter to Lord Palmerston, ... 34

Geological Inquiry respecting Water-bearing Strata. By G. Prestwich, ... 116
Geology, Student's Manual of. By J. Beete Jukes, ... 138
Geography, Physical. By Mrs. M. Somerville, ... 149
Gosse, P. H., Letter in reply to Mr. J. Beete Jukes, ... 126
Gray, Dr., Edition of "Turton's Manual," by, ... 157
Ground Beneath Us. By G. Prestwich, ... 116

Hoeven, van der, Handbook of Zoology. 2 vols., ... 84

Insect Hunters. By Edward Newman, ... 64

Jukes, J. Beete, Letter to Editors from, ... 106

Memoir of the late Dr. R. Ball, ... 1
M'Clure's Discovery of the North-West Passage, ... 65
M'Clintock, Captain, Letters from, ... 165, 169, 170, 182

Page.
Naturalist's Rambles on the Coasts of France, Spain, and Italy. By M. A. de Quatrefages, ... 95

Omphalos. By P. H. Gosse, ... 55
—— Mr. J. Beete Jukes' Letter on Review of, ... 106
—— Mr. P. H. Gosse's Rejoinder, ... 126
—— Conclusion of the Controversy, ... 184

Personal Narrative of the Discovery of the North-West Passage. By Dr. Armstrong, ... 63
Petrology, Comparative Essay on. By M. G. Durocher, ... 159
Polyzoa, Monograph of Fresh-water. By Professor Allman, ... 60

Quatrefages' Rambles on the Coasts of France, &c., ... 95

Resolute, Eventful History of the. By G. F. M'Dougall, ... 119

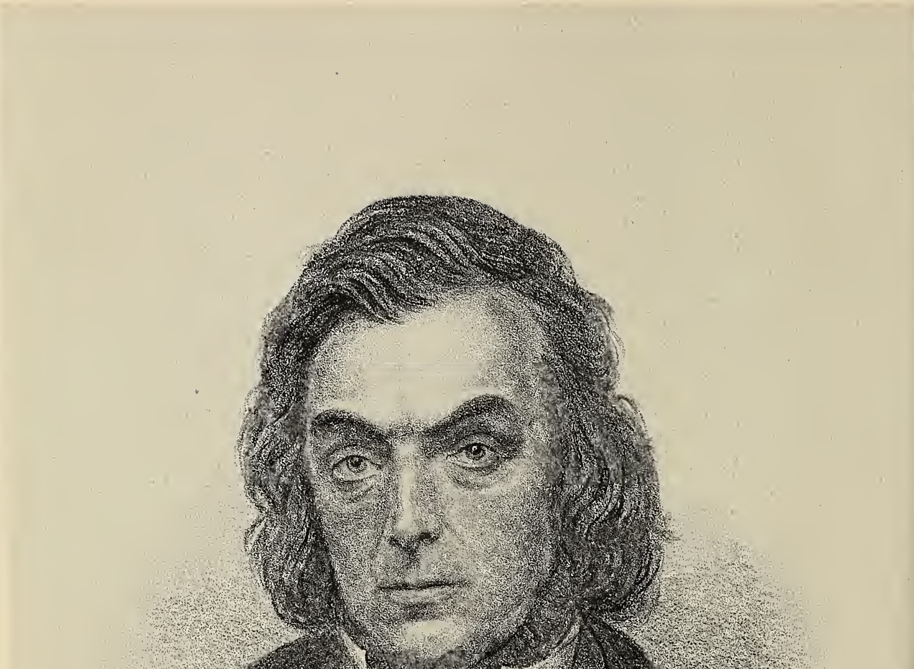
Sea-side Studies at Ilfracombe, &c. By G. H. Lewes, ... 98

Turton's Manual of Land and Fresh-water Shells. By Dr. Gray, ... 157

Uniones, on American, and other Shells. By Dr. Lea, ... 105
United States Expedition. By Dr. Kane, ... 119

Zoology. By Dr. Carpenter. New Edition by Dallas. Vol. I., ... 49
—— By Dr. Carpenter. New Edition by Dallas. Vol. II., ... 111
—— Handbook to. By Dr. van der Hoeven, ... 84

Zoophytes of Durham and Northumberland. By J. Alder, ... 63



Robert Bull

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Memoir of the late Robert Ball, LL. D., M. R. I. A. By Robert Patterson, M. R. I. A., &c.

[The Editors of the "Natural History Review" felt desirous of publishing in the pages of their Journal some biographical notice of their lamented colleague, the late Dr. Robert Ball, so that those who knew him might possess in it a memorial of their departed friend, and that those who knew him not might understand why his death excited such unusual regret in the scientific and literary circles of the Irish metropolis.

They were pleased to intrust to me the honourable though melancholy duty of preparing such a memoir. The family of my valued friend kindly offered me any assistance in their power, and access to letters and documents in their possession. Thus encouraged, I have endeavoured to prepare, not an "Eloge," but a simple sketch that may present him "in his habit as he lived;" and in so doing I have used, when practicable, his own words, as embodied in letters and memoranda.]

Robert Ball was the son of Bob Stawel Ball, of an ancient and respectable family, who came from Bampton, in Devonshire, and settled in Youghal in the year 1651. He was born at Cove (now Queenstown), county of Cork, on the 1st of April, 1802. From childhood he manifested a strong spirit of inquiry. A note, written by himself, says:—"I was often quizzed for my infantine expression of 'What's that?' 'What would it do to a person?' and rated for breaking musical toys to ascertain the mode in which the sound was produced." In animals of all kinds he took especial delight. On one occasion his teacher, observing that he was not paying attention to his lessons, inquired into the cause, and found he held in his hand a live lizard, which he took every opportunity of looking at, and playing with, under the table.

Among his pets was a kite, which had been brought to him with a broken leg. He made a wooden one, and this answered so well that his feathered favourite hopped about on it long afterwards at Youghal.

He was remarkable from his earliest childhood for his truthfulness. Once only he was punished by his father, in consequence of his being suspected of breaking a valued rose-tree. He positively denied the act, though he bore the punishment quietly; the following day the true culprit was discovered.

When nine years old he was sent to the Rev. Dr. Stewart's school, at Clonakilty, county of Cork. That his observant faculties were then active may be inferred from a passage in one of his letters to his friend, the late William Thompson, Esq., of Belfast, dated March 3, 1840:—"I have told you before that I found two shells (*Physa*), when nine years old, near Clonakilty, which I deposited in my little cabinet at vacation time."

Another instance of the same characteristic, which occurred when he was a year older, is narrated in a letter to the same friend, dated December, 1839:—"When a boy I remember watching a turtle resting on the surface of the water in the harbour of Cove; it went down on coming near it."

Perhaps, however, the most striking instance of his early powers of observation is that which he himself afterwards communicated to the Dublin University Zoological and Botanical Association:—

"I recollect, when I was but a child, the many delightful days I spent in examining animals on the shore, and I am conscious of having at that time seen many rare species, not a few of which have since been brought forward as recent discoveries. I may instance one,—the *Cydippe pomiformis*, which I distinctly recollect to have seen when I was not five years old. I found it in a pool, and brought it to my father as the lens of a haddock's eye, which had come to life. I quite remember its cilia and iridescence, and how deeply I was absorbed by its beauty."—(Nov. 16, 1855.)

He was afterwards transferred to the school of Mr. James White, at Ballitore, county of Kildare. This gentleman had tastes in some respects congenial to his own, and was therefore disposed to encourage the natural history pursuits of his pupil. The friendship that sprang up between them did not cease with the school-days of Robert Ball, but continued in after life. There is now before me a letter of Mr. White's to him, dated "1st Mo. 19, 1835," stating that he had sent him by a carrier some living specimens of a lamprey (*Petromyzon*), the species of which appeared doubtful. Mr. White also asks where he shall find a description of the urchin (*Echinus*), "that hollows for itself a hemispherical lodgment in stone," adding, "I have sought it in vain in Cuvier, Blumenbach, &c." The schoolmaster who was directing his attention to such inquiries showed an appreciation of zoological science far in advance of what was usually met with at that period.

Of those who were the companions of Robert Ball at Mr. White's

school, few now remain; but among those few is Dr. Longfield, one of the Commissioners of the Incumbered Estates Court. That gentleman, in answer to an inquiry respecting the appearance and habits of his schoolfellow, has most kindly furnished the following note:—

"He did not remain long at that school after I entered it. That circumstance, combined with the length of time (nearly half a century) which has since elapsed, makes me unable to give much information about his pursuits and habits there. I remember, however, that he was about my own age, was very slight and tall for his years. He was a pleasant companion, from the good temper and fairness with which he played tops, balls, marbles, and all other childish games. He used also to entertain us with stories of cranes, seals, and other animals. He was the only one of our class of *little* boys who had ever seen a seal, and he was never tired of telling stories about these animals, nor we of listening to them." These are "the trivial, fond records" of early life, the recollections preserved by relatives and friends; yet the biographer would be justly blamable if, because of their being trivial, they should be blotted out. They shadow forth, even in their triviality, the future man; they demonstrate the existence in him of tastes and habits which were rare at that time, but which, happily, are so no longer.

The ability which Ball displayed at Ballitore recommended him to his teachers, and the genuine kindliness of his disposition made him a favourite with his school-fellows. He is described as having been gentle and docile, fond of making experiments on birds, frogs, &c., retreating sometimes to his own room for that purpose, and when interrupted by the boys, driving them away with his bolster! He was blessed with high spirits and great bodily vigour. It delighted him to use a large bow and arrow; the bow was one that no other boy at the school could bend.

One cause of complaint, however, existed against him, and not without reason. The worthy lady who at that time took especial charge of the boarders' clothes, and who is yet living, could not infuse into young Ball her own innate love of neatness in regard to dress. His clothes were occasionally torn, and often soiled or dirtied, while he was intent on obtaining some specimen, which to other eyes seemed worthless. A limestone quarry near Mr. White's residence was rich in fossils, and these lured him in his play-hours to efforts which were frequently damaging to his habiliments, and not at all conducive to habits of personal tidiness.

At the age of sixteen he left Ballitore and returned home to Youghal. During the next few years his bodily frame was gradually developing itself by active outdoor occupations, and his observant powers were in constant exercise. Not, however, content with merely *observing*, he *recorded* much that he saw, and sought to classify and arrange the multifarious objects which a sea-side residence brought under his notice.

His occupations were very diversified, including drawing, wood-turning, classical reading with a tutor, and physical science, so far as it could

be carried on in the observatory of Dr. Dartnel. He read much, and as his memory was retentive, it is probable that the miscellaneous books which then fell into his hands contributed largely to the varied characters of the information he possessed.

It was during the years now spent at Youghal that a large amount of his extensive zoological knowledge was acquired. He fought his way to it alone and unaided, and through difficulties which would have deterred one who was less in earnest. An early friend of his, and one whose friendship throughout life has been "without variableness or shadow of turning," Richard Dowden (Richard), of Cork, has kindly supplied some memoranda, from which the following passage is extracted:—

"Dr. Ball was a self-made naturalist; he enjoyed no opportunities of an assisting nature; he had no one of any position in his science to applaud or sustain his exertions; indeed, on the contrary, the only person who gave attention to science, in Dr. Ball's contiguity, was interested in natural philosophy, and rather contemned 'the preparing of skeletons on the sea-shore, and such' (as the natural philosopher called them) 'useless and slovenly operations.' But Dr. Ball worked on; he did not depend on sympathy for his encouragement, and the only help he sought for was aid in determining a species, or establishing a habitat, or an animal's habit. This kind of inquiry in a country town, thirty miles from a very moderately supplied natural history library, had its difficulties and its disappointments. Dr. Ball, though he left us in the very vigour of his life, began his natural history progress at a time when a literature fitted to help him did not exist in the extent which may now be easily commanded. Descriptions were carelessly and obscurely given; writers often contradicted each other, and put the inquirer into confusion; any of the less common objects were scarcely known, and 'Shaw's Miscellany of Natural History, in twenty-four duodecimos,' was considered the cyclopædia of marvels, where everything beyond the most every-day objects in natural history was to be found. There were other books in great metropolitan libraries, but when postage was high, when railroads were unknown, and when travelling after knowledge was rare, the resources of a provincial investigator were rather limited. I record these facts because they may indicate to young men how much of our progressive power is our own. No doubt every facility should be prized and taken advantage of; but when we find zeal and perseverance thus making a noble triumph over most discouraging wants, it is obvious that earnestness is the first power leading to success, and that, without it, no abundance of materials can make any man a really well-informed and useful naturalist."

At all periods of his life Dr. Ball devoted much of his energy to institutions having reference to the well-being of others. Accordingly, as he approached the age of twenty-one, we find him taking part in the management of the Loan Fund in Youghal, the Savings Bank, the Fever Hospital, and the Library and Reading Room.

Great distress unhappily prevailed about this time among the starving poor, and large collections made for their relief were confided to him.

For his prudent conduct as Secretary and Treasurer to this fund, he afterwards received the marked thanks of his fellow-townsmen.

In the year 1824, a few months after coming of age, he was appointed a local magistrate, and, in the active discharge of his duties as such, encountered the risk of assassination, from which he more than once narrowly escaped.

He was afterwards introduced to the Duke of Devonshire by Mr. Abercromby. Both were interested in his welfare, and he sought their aid to procure some metropolitan employment, which would enable him to pursue the study of medicine without expense to his father. His request was kindly met, but with an expressed desire that he should abandon his studies, and enter the Government service.

Furnished with a letter to Lord Melbourne, then Chief Secretary, he went to Dublin in 1827, and was appointed to the third clerkship in the Constabulary and Yeomanry Office. The duties were onerous, but were entered on with zeal and determination. To his father he writes:—"I have determined not to embark in any other study at present besides that of making myself acquainted with the duties of my office." In another letter he says:—"I have been hard at work for ten days from 10 o'clock until after 7 o'clock." And in 1828 he writes:—"I am at present too hardly worked to attend to any very serious studies."

On the 6th of January, 1829, he writes thus:—"New Year's day, though a holiday, I devoted to finishing off all business connected with the last year. When done, I made a comparison between the quantity of duty performed by me since I came into office, and a similar period of my predecessor's (viz., 13 months). My correspondence occupies 1281 pages; his, 491. Letters have increased seven-fold, and other business in proportion. I merely mention this to prove that our labours are something more than nominal."

His subsequent letters to his father show that he did not find scope for his energies in the routine duties of the office, and that he longed for a change. 1829. "Should any opportunity be afforded you, I wish you would let it be understood how gladly I should accept any more personally active employment, holding out brighter prospects, though without even so much of present emolument; as, in the changes in Government regulations about to be made, I may be thrown out, when too late to turn with hope of success to any other pursuit. My former occupations and acquirements would be of much advantage to me in other ways, but are of no use to me at present."

The following is in a more animated style, caused, doubtless, by the pleasure of having spent an entire day in the open air, engaged in agreeable excitement in company with one of his most valued friends:—"Yesterday was the King's birth-day, and instead of going to the review, I went with W. Todhunter to Howth, on a cruise against the seals. We had a grand battle, and succeeded in securing one fellow of about four cwt. It was very exciting; we went armed with grains and guns; we saw three seals; the first got off clear; the second we struck with our harpoon, but, though tolerably deeply wounded, he got off, leaving us

only a little blubber. The last fellow Mr. M. and I struck; I buried my harpoon to the shaft in the shoulder, in about eight feet of water. He took our boat out of the cave with amazing rapidity, and, after hauling us about for some time, was obliged to put up his head, when we succeeded in dispatching him, but not until we had fired four shots, though our harpoons were so bent, and the shafts so broken, that we had to go to the lighthouse to get them repaired. When they were done, the swell had so increased that it became impossible to approach the rocks; we were then caught in a squall, and shipped a few seas, but got safely into a creek in Howth, and came home in the evening with our prize. On examination, my harpoon had penetrated the ribs, lungs, and heart; so much for gymnastic vigour. The creature measured 7 feet 2 inches in length." It is now in the Museum of Trinity College, Dublin.

The next five years (1829 to 1834) contain few events to record, but his letters to his father show a constant desire to escape from the thraldom of the office desk to some more active employment. He still clung to the idea of entering College and going to a profession. At one time he thought of applying to be made a stipendary magistrate; at another, he looked with a longing eye towards India. Anything demanding vigorous intellectual effort would have been hailed with pleasure, as much superior (to use his own words) to "a state bordering on inanity, caused by a long course of stupid work."

A few extracts from his letters tell all that need be told. In one respect they are remarkable—for the extreme deference which they uniformly evince to his father's opinions and wishes.

February 25, 1830. "There are in course of appointment a number of stipendary and resident police magistrates throughout the country; and from my knowledge of some of those already appointed, I am led to think I would not be an unfit candidate."

The two following are of the same year:—

"We are kept closely employed from a little after 10 until 7 each day, and I understand we have no chance of any intermission of this continual application. There are some other circumstances equally unpleasing, but as I am not allowed to make any attempt to relieve myself of them, I must only submit."

"I cannot refrain from expressing a desire that you would consult with ———— as to my engaging in some professional pursuits; for, not to mention the unpleasantness of my present situation, its precarious tenure would be sufficient to make me desire some future source to look to, independently of my anxiety to advance my mental powers (which at present appear to be retrograding, and which, without some ultimate object, I have not sufficient energy to cultivate). I am inclined to think that some important changes are contemplated, which will be much to my disadvantage. I cannot help putting you in possession of my wishes, which, should you still consider futile, I will endeavour to suppress."

1831. The letters of this year contain frequent reference to hard work:—"I was employed until 3 o'clock Wednesday, A.M., in conse-

quence of a Return called for in Parliament. I have been for weeks together working twelve hours a day."

In December he was made Assistant Librarian and Keeper of Records:—"This, I hope, will be more instructive than my present occupation; my duty being to read, index, and make minutes of the several papers submitted to Government; and will afford opportunity for acquiring a very considerable knowledge of the State. Being an improver and inventor of the index, has probably put me in for this." 1832. "I have not yet made up my mind about the College affair; it would cost me over £100 to enter as a Fellow-commoner and to take rooms in College. As I cannot muster that sum, this course cannot be taken, and it would take me several months' preparation to enter as a Pensioner." "I have credit in the new office as a clever machinist, having suggested a copying machine on a construction, I believe, entirely new; I obtained leave to have two of them made."

"As I have received no reward for extra labour, I have determined not to undertake more than my neighbours; I shall then have more time to myself, which I may dispose of usefully in acquiring a profession. J. W. is just about to sail for India as a surgeon to an Indiaman; this, though no great speculation, yet as possessing manly enterprise, and affording room for acquisition of knowledge, would be to me far preferable to drudging away life at a desk, for merely the means of existence."

In this year a consolidation of the different branches of the Chief Secretary's Office took place, and to his surprise he found himself at the bottom of the new office, having eleven placed between him and a certain amount of salary, where only *one* had been before. This was a grievous injury, and he waited on Sir William Gosset, Under Secretary, who acknowledged the hardship, but said that a compensation for immediate injury was given by the better ultimate prospect of £800 per annum. Thus he was again dissuaded from seeking a professional education.

Neither office-work nor official vexations could quite chill his efforts. The mind would be at work; and a letter addressed to the very Rev. the Dean of St. Patrick's contains the expression of opinions, which, though generally received now, were, a quarter of a century ago, regarded as questionable.

"I have often thought how much the cause of true religion would be strengthened by the support of science, in such cases as it is applicable to it, leaving the portions of Revelation that are beyond human reasoning to themselves. And much have I felt how it has suffered by attempts to make *demonstrably* true science bow to the *letter*, not the *spirit* of Scripture; a practice which I believe has often made the youthful philosopher an infidel, for, satisfied that his teacher is wrong in some instances, he is too apt to presume that he is wrong in all."

A letter to a relative (1833) says, in speaking of Kirby and Spence's "Entomology:"—"The two first volumes may be read with interest even by that *diseased creature*, a novel-reader, provided the malady be not

of long standing; the other two are more serious affairs, but will amply repay the labour of studying them, and leave the mind charged with a quantity of matter capable of affording enjoyment for the longest life." The letter graphically compares the "out-and-out novel-reader" to a dram-drinker, and dwells on the injurious mental effects of reading devoted too exclusively to common works of fiction. In 1832 he became a member of the Geological Society of Dublin. In June, 1834, he enjoyed a holiday excursion with Mr. Thompson to Arran, visiting, before his return to town, Killarney, Cork, and Youghal. Many observations then made by these brother naturalists and friends were duly recorded by Mr. Thompson, and eventually published.

While, however, his Castle duties went on daily, he was gradully becoming known outside of the "office." His retiring habits did not prevent his information and abilities from being recognised by those who were able to estimate them aright. Such men were soon converted into personal friends, who were glad to draw him into their scientific and literary circles, and offer to him those graceful hospitalities for which the Irish metropolis has been justly celebrated. His life may henceforward be regarded under two aspects,—the official and the scientific. Let the reader "look on this picture and on this:" they are widely different, yet they each convey to us a true representation, not of the external condition, but of that which is unseen, and which constitutes the real life of man.

The letters to his father during 1835, 1836, 1837, are numerous, and many of them contain complaints of Castle work. His duty there would appear to have been particularly arduous or unpleasant, for he states that he had offered a sum of money as an inducement to any of the other clerks in the office to exchange with him, and they had all refused. Nor was he more successful in his application to the Under-Secretary, for that gentleman said the duty was so well done he must refuse to make any change. The most real and tangible hardship, so far as is apparent from the letters, arose from a stranger having been appointed, in 1835, to the head clerkship of the office,—thus extinguishing the hope which Ball had entertained of ultimate advancement. Amid all this occupation Natural History still made her way to him, and soothed many a weary hour. His zoological knowledge was becoming more generally recognised, and for months not a day passed during which specimens were not submitted to him for examination. He did not, however, allow "the voice of the charmer" to interfere with what was prescribed by that sterner monitor, public duty. In one letter he uses the remarkable words (under date January 19, 1837):—"Whatever may be my inertness and inattention to private affairs, I can most conscientiously declare that I have been the *most* zealous public servant I know, and have rendered really very important services, and never neglected any duty intrusted to me, or involved the Government in difficulty."

Disappointed in his hopes of advancement, and dissatisfied at the remuneration paid for his labours, he looked with complacency on every

project that promised an escape from desk-work, and an energetic, independent career of usefulness. It is not strange, therefore, that at times there flitted before him a vision of New Zealand, and that for years after this period his thoughts turned towards its proffered freedom. In one letter (9th February, 1839), in speaking of the colonization and improvement of that country, he says:—"I am physically and mentally particularly well suited for the work; and though banishment from the many friends I possess would be most painful, yet the high nature of the service to be attempted would console me."

The intervening years from 1834 to 1840 were eventful and important both in his social and scientific career. On the 12th January, 1835, his friend William Thompson, Esq., of Belfast, wrote to him in the following terms:—"As you have not at present sufficient leisure to impart (in print) your accumulated knowledge of the Natural History of this country, I mean to forward for publication all you communicate to me, in your own name, and mark it off with inverted commas as your production, doing, at the same time, as I would be done by, in correcting any verbal matters that in your haste did not claim a second thought." Such was the simple commencement of that correspondence which did so much to elucidate the Fauna of Ireland, and has preserved hundreds of observations made by Dr. Ball, which would otherwise, in all probability, have perished with him.

It was in this year, 1835, that I first became acquainted with Ball. I was introduced to him by a note from Thompson, which now lies before me. From this period until his untimely death our correspondence continued, progressing from the topics which belong to literature and science, until it included those whose province is the domestic hearth, and which flourish only in the atmosphere of a happy home.

In the early part of this spring he became a member of the Royal Irish Academy, and was elected on the Council of the Zoological Society. He paid a visit, with Mr. Thompson, to Ireland's Eye, and mentions that he got "one hundred and fifty specimens of plants, and upwards of fifty species of algæ." He speaks in high terms—which all who have used it can corroborate—of a varnish specially adapted for natural history specimens, and a mode of preserving fish "which really is superlative." In that summer the British Association for Science held its meeting in Dublin. Ball took, of course, an active part in what was going on:—in the business of the Natural History Section; in the arrangements at the Zoological Gardens for the visit of the Association; and in acts of attention and hospitality to many of its members, with whom he then formed a personal acquaintance. At this meeting he was requested to investigate the mode in which the *Echinus lividus* excavates the rocks on which it is found.

The year 1835 was memorable in another respect. In it he accomplished a visit to the islands of Arran, lying off the west coast of Ireland, at the entrance of Galway Bay. His companion was the Very Rev. Henry R. Dawson, Dean of St. Patrick's, whose splendid collection of antiquities now graces the Museum of the Royal Irish Academy.

The excursion occupied only nine days. Immediately after his return Mr. Ball committed all the little incidents of the tour to writing, in the form of a journal addressed to one of his sisters. Nearly a quarter of a century has since passed by, and Time has been busy in the interval, changing to the visitor the mode of locomotion, and much that was peculiar in the physical and mental characteristics of the inhabitants. Some interest attaches to the narrative, as conveying the impressions formed by two observant and intelligent travellers; but the extracts now given have been selected for a different reason. They convey the most truthful, the most unstudied evidence of the mind of him by whom they were written. They show his quickness of observation, and his range of zoological knowledge; his quiet enjoyment of the ludicrous, and his wish practically to inculcate anything useful. In the peculiar and somewhat antiquated style of expression, those who were intimate with him will recognise phrases that to him were habitual. The Dean appears throughout in the most amiable light, putting up good-humouredly with the rude accommodation which the locality afforded, and desirous on all occasions of forwarding the pursuits of his companion.

The travellers started from Dublin by the night-mail on Monday, the 8th of June, and reached Galway next morning. The Journal, which is termed by its writer, "Account of a Travel into Arran and county of Galway," informs us that they sought a "native boat," and started for Arran "in a miserable hooker, laden with salt and women, taking as a sea-store two lobsters." It fell calm, so that they had to remain on board during the night, but "had the use of the quarter-deck conjointly with an old woman, who never had a cap, bonnet, shoes, or stockings; and a sailor, fisher, smuggler, who never had his feet cased in aught but pomputies, with a Gospel tied about his neck to protect him from peril at sea and dangers by land, and for which he had paid his priest half-a-crown." The peculiar article of dress just mentioned as worn on the feet of the sailor is thus explained:—

"The pomputie is the only peculiarity in the dress of the men. It is a sort of shoe made of a single bit of raw hide, drawn up by two strings, and is really a good thing for travelling over rocks. The women's dress is very peculiar almost all through the county of Galway and places thereunto adjacent; it is simple, and looks well. The great majority wear only a jacket and petticoat of a red crimson, subdued, coloured woollen stuff; their hair Madonna style, twisted up at the poll; feet bare; a few of the richer wear shoes, and stockings of a kind of powder-blue colour, and cloaks to match. These harmonize very well with the red garments, and give a picturesque effect."

"We arrived at 5 o'clock A. M. in the island of Arran, and found a fleet of boats just going to fish. The women, in their reds, coming down to the shore with tubs, &c., for the salt we had on board, had a fine effect. The morning clear and fresh, the sea as transparent and smooth as glass, and nothing to break the silence save the noise of the sweeps (large oars) of the boats going out, and the Irish jargon of the women announcing how many pounds (they are too ignorant to count

larger weights) of salt they had got, to their friends on shore; the men were all at sea.

"The island consists of a barren and in most cases a naked rock. Each house has, in consequence, one advantage over any elsewhere: it is, that the floor is invariably a single flag; as, indeed, are many of the fields, which, strange to say, are walled-in with great care. It cannot be for the trifling herbage that springs from cracks or fissures, generally many feet asunder; it should rather be ascribed to the desire man has of asserting his right of property, the more strongly as the matter in question is least worthy of contention. I must now describe our hotel: it was a cottage of three rooms and a set-off, with a courtyard in front. We became the tenants of the principal room, from which an officer of the Waterguard was ejected without ceremony. This room contained two beds, built into the wall after the fashion of the berths of a ship; a dresser, with a teapot of awful dimensions, and two or three glasses and plates upon it; a table and two chairs of deal, beautifully perforated by that most ingenious chap, the *Teredo navalis*. The ornamental part consisted of a chaplet or necklace of sea-fowls' eggs. This hotel is like an expanding portmanteau, and accommodates inmates *ad infinitum;* as the landlady told us she had seventeen, besides herself and six children, in it a few nights before; and while we were there, there was a considerable influx of visitors, who were at once taken care of, but did not encroach on our territory.

"The O'Flaherty we met advancing. He led us to his house, and offered sundry edibles, which we declined; and he accompanied us to Dunengess,* the mighty fortress of a race of which no record remains. It is in magnitude almost a Colosseum, and when perfect was an ellipse, the transverse diameter of which was ninety-one feet. A portion of it has, with the cliff on which it stood, long since fallen into the sea. The wall is curiously constructed, being, in fact, a triple wall in contact, so that if the outer were battered down, a perpendicular face would still present itself; and so of the next, giving a great opportunity to the defenders to punish the besieging foe. It is built of large, naturally-squared stones; and but two entrances remain: they are very small, about 5 feet 6 inches high. The wall is 15 to 18 feet thick, and may have been 40 high. It is surrounded at some distance by two other walls, outside which is a species of stockade composed of long, sharp-pointed stones, set with their points inclining outwards. Even at the present day it is no easy matter to get through them. In the interior of the building the rock forms a natural table of gigantic proportions, and in the cliff which intersects the building the sea-fowl breed. The magnitude of the whole, considered conjointly with the spirit and capabilities of the present wretched inhabitants of the island, make it the

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* In the sheet published for the use of the British Association visitors in 1857, this is spelled Dun Aengus, and it is stated that this name "is derived from Aengus (chief of the Firbolg Clann Huamor), who, with Concovar, his brother, was granted these islands by Meave, Queen of Connaught, shortly before the general Christian era."

more puzzling to guess who or what people raised so vast a fabric. There are many other buildings of great magnitude which we saw in the island, apparently constructed as places of defence. What they who built them had to lose on so barren a rock, or they who attacked to gain, is beyond my ken.

"After leaving this building I went to where Thompson and I found the Astragalus: it was not; and a fear came over me that we should suffer in fame, as Sir Charles Giesecke has done, in finding a plant that could never again be discovered. However, I at last made it out in considerable quantities, collected it, and sent it to the College Garden, where it now grows stoutly. From this we visited the breeding-places of birds (the *Alca torda*, *Uria troile*, and *Larus argentatus*), and saw them in vast numbers in the act of incubation. We saw where a powerful anchor and chain-cable lay at the foot of the rocks, marking the place that a stout ship had struck on a few months before. The O'Flaherty and many others saw her from the cliff above; she drove right on the rocks, and in a few moments nothing was to be seen but fragments floating in the waves. With the power of an hundred men, they dragged the smaller anchor up the cliff; the larger is so fast tangled with its cable in the rocks, that it must stay as a mark of the wreck until it rusts away its solitary existence. The O'Flaherty here showed us a curious phenomenon: it came on to rain heavily, and he told us to sit on the edge of the cliff, and we should not get wet. We did so, and found that the rain was thrown over our heads in an arch of about five feet high; we did not get a drop.

"We then went our way for the Seven Churches, ruins of a small size, well built, and far surpassing the present erections in the island. On our way we gathered sundry curious plants: the maiden-hair (*Adiantum capillus-Veneris*), of which capillaire is made, and which the Arranites use as a medicinal tea."

The O'Flaherty, with the proverbial hospitality and kindness of the old Irish gentleman, had expected they would stay at his house, and was much disappointed by their refusal.

"We got to the hotel about 10 o'clock P. M., and, having eaten dinner, I forget of what, we went to bed, but not until I had put up my plants, and commissioned fellows to work for me in procuring eggs, birds for Garden, and specimens of the *Echinus lividus*. Not having lain down for two nights, save a sort of loll on the hooker's little deck, which a fellow prepared for us by washing or rather softening the filth on it with a wet swab, I had a glorious sleep for six hours. Getting up, the amiable Dean, seeing it a fine, calm day, insisted on my taking advantage of it by dredging for shells. The O'Flaherty joined us, and having procured the boat of the Waterguard, we set off towards Straw Island, passing over, in the first instance, vast fields of *Zostera marina*, which you may see so often puffed in the papers as *Alva marina*, superior to hair, &c., for beds. I endeavoured to teach the natives the use of it, for it is really useful as a material for bedding; but I doubt my lesson was thrown away, the answer, 'we never uses it,' being quite

conclusive. I saw a woman salting gurnard with the heads on, while cod and other fish with edible heads were decapitated, and the heads cast away. I endeavoured to show her how she was wasting a large portion of salt in preserving what was useless: she replied, 'we always leaves the heads on gurnits;' and this she repeated so often as to make it seem hopeless that she would not continue the old practice. Having passed the Zostera, we continued dredging; caught sundry Crustacea, and got a few shells and Algæ, but nothing rare.

"We landed on Straw Island, where we found the Matthiola in great profusion. It is the parent of the stock gillyflower of the gardens; it is all purple, and possesses much more odour, I think, than the 'tame' plants. We found here the eggs of the tern (*Sterna hirundo*), and I shot the beautiful *Hæmatopus ostralegus*, or oyster-opening plover.

"The Dean got at the cottage a curious little article that is sometimes hung about the necks of children, particularly, we learned, in the county Clare; it is called a plough-tackle, and consists of a ring of iron, having little trinkets, shaped like the various parts of a plough, of the same metal, on it. We saw a hooker, which had come from Connemara, leaving the island, being unable to find a purchaser for its cargo of turf at ten shillings, though the article is a chief necessary. The people seemed in great apprehension of an inroad from the starving people of Clare, who threatened an invasion, not to take away the potatoes gratis, but by force, paying one pound a barrel; showing a curious mixture of justice and robbery: justice, as a pound was more than fair value; robbery, as force was concerned.

"Leaving this island, we now reached the middle one; it being late, we hurried along, but saw several interesting matters: three druidical altars, consisting of a large flag, supported by two others; these stood on fields of flagstones, within a short distance of each other. It is strange that three islands so very near each other should seem to have been inhabited by people who have left such marks of their having been distinct races, as the buildings evince. We observed here, as indeed all through, the extraordinary love the people seemed to bear to the O'Flaherty.

"We saw on the island the Astragalus and Adiantum, and on the shore the *Trochus crassus*. It was here last year I found Baugiæ, a purple Alga, growing both in fresh and salt water. We were much delighted with a rich display of luminous creatures, of a species I never saw before. It was about 11 o'clock P. M., and they appeared around us in vast profusion; but when I let down my dredge into the Zostera it was really splendid: a mass of light quite illuminated the space under the boat. Individually the creatures were best likened to spangles of silver, the hole in the centre and slit representing the little worm, and the flattened disc its luminosity. I brought up abundance of them in the dredge, but they were too frail and miuute for preservation, and I had no microscope to examine them with.

"On getting up this morning I found a levee in attendance, having coins, &c., for the Dean, and birds' eggs, Echini, and rocks, for me. The

Dean got nothing good; I got *choughs*, and upwards of a hundred eggs of sea-fowl, but, most valuable, a quantity of the *Echinus lividus* of Lamarck. This creature burrows in the limestone rocks, making a teacup-like cavity, in which it holds with great pertinacity; it is besides well to look at, having large spines, and being of a rich purple colour. Having set a fellow to clean out the specimens, we proceeded to the shore, the Dean again bent on furthering my pursuits, searching under stones, &c., for all manner of creeping things. He soon found a species of Holothuria which I have not as yet made out. I found the *Syngathus ophidion*, new, I believe, to Ireland; and a few Algæ, which will add to your collection. I caught the *Cetonia aurata* and another Cetonia.

"We here found a poor fisherman with a single lobster-pot and a rod; he had just caught the largest lobster I ever saw, which he would have sold for a sixpence. He told us he was too poor to be able to attend to or have more than one lobster-pot; and I am sure he would not take a present of another, having always had only one. It would take more than a generation to effect any improvement in such a people.

"Seeing a building on the high ground, we asked our guide what it was; he could give us no other answer than, 'we calls it the look-out.' However, as it seemed too good a structure to be of recent date, we climbed our way to it, and were rewarded. It proved to be a well-executed little building of cut stone, 11 ft. long inside, by 6 ft. 8 in. in breadth, having a curious door 5 ft. 6 in. high, and 1 ft. 4 in. wide at top, expanding to 2 feet at the bottom; the height of the side walls only 5 ft. 2 in.; it had a very steep roof. The door was so narrow that no ordinary man could get in, except sideways. The savages are pulling down the little edifice from mere wantonness. It was not, perhaps, a Christian church, as its direction is contrary to that given in such places of worship. Near it are some of the ancient bee-hive houses, specimens of which are met with throughout Ireland; but in other places, under ground; here, the rock being at the surface prevented concealment. The stones in these houses were all laid horizontally. Here there is the base of a Round Tower, thrown down by the people to build their cabins, though nearly as good stones were all around them naturally on the surface of the ground. Here is also a holy well, at which was a woman praying, and our guide would only approach it with his head uncovered, though he spoke but lightly of his priest, &c. It appeared that the well belonged to his patron saint. Below this, according to his account, was a monastery, which once contained 700 monks. They were all put to death, and their habitation razed, by a rover. Further down on the shore is a remnant of a Norman-like fortress of considerable extent,—according to the guide, built by Cromwell.

"I believe I did as much in natural history as was practicable, but could have found employment for a week with ease. Having first made a scamper to the shore, I gathered more Algæ, and found the *Voluta*

lævis, purchased a pair of pomputies and more choughs. We took leave of our friends, and, mounted on the backs of stout natives, were embarked on board our boat, never, perhaps, again to visit Arran."

This was not the case. In 1840 its productions were again explored by a party of naturalists, of which Ball himself was one.

They had a prosperous voyage to Galway of five and a half hours. While there they crossed the river to look at the weirs. "Seeing some fine trout in the pond, of various kinds, I determined on getting them, and succeeded in procuring three, the largest weighing 9 lbs. I sent them off by the coach, with orders to H. R. to show them to Thompson, for Yarrell's work; or, if I were not in Dublin, to pickle the heads."

"We stayed up for a gentleman who was to have produced sundry curiosities; he did not come, and I employed myself in writing four letters. I was there at work until long after 2 o'clock, packing up my treasures to send them by the mail to Dublin, was up again a little after 3 o'clock; and having got a bowl of milk with a little whiskey, we started for Connemara."

They arrived at Flinn's half-way house.

"While fresh horses and car were preparing, we chatted with his daughters, two tall and, strange to say, elegant-looking girls, with beautiful figures, never deformed by the cruel foolery of stays, or corsets, or cinctures. The one was knitting real Connemara stockings, while the other, barefooted, was spinning the material for them. Their hair was put up with great taste, precisely after the fashion of Canova's Venus, and their graceful movements and gentle manners were in strict accordance. Yet they were only peasant girls in the very centre of Connemara. The only fault I found in them was one in which they resembled fine ladies: it was the abhorrence expressed in their countenances when I seized a magnificent specimen of a nomade spider, which dropped from the smoked roof of their cabin. They expressed their feelings in Irish, and I caught the word *Prumpillaun*,* and said, 'Here are some,' producing a box of beetles. They were certain that I had consequently understood all they said, and seemed in dire confusion."

"We stopped at an ancient hill fort, and having made out the covered way which led into it, endeavoured to open it from the top. After considerable labour, we failed in making a practicable breach; and a number of country boys having assembled around us, we determined on astonishing the natives. I was dressed in my white cloak and cap, and with sundry gesticulations cast into the hole three Promethean matches, which I ignited by biting with my teeth. I then contrived to slip in father's musical watch, and we had a tune from the bowels of the earth. After certain mysterious allusions we walked off in silent dignity, leaving the spectators looking on with the strongest expressions of wonder in their countenances!"

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* A black beetle.

"On our way to this cottage (the Corrib Hotel) several fine Sphingidæ passed us. They were large, and of a bright brown colour, but were too smart for me, though, at the risk of my neck, I jumped off the car and gave chase."

Next morning they started for Corrig, driving along Lough Corrib:—"Arriving near Corrig, we went to see the Pigeon Hole, a cavern, the descent to which is by many steps. Through it runs a pure river; it was shown to us by a woman of perhaps seventy or eighty years of age. She added much to the wildness of the scene, being a shrivelled hag of considerable activity; in this visit she did not cut as picturesque an appearance as when first I saw her, last year. It was late at night, and she had her gray hair hanging dishevelled on her back, her body almost naked, more concealed by smut and smoke than by clothing. As she stood on a dark black rock at the end of the cavern in the foam of the subterrene cataract, I thought her more like the witches of romance than anything I had ever seen, as she waved her blazing wisps of straw around her head, rendering the dark depths of the caves partially visible. In the river running through this cave are trout, which the people call holy fish. To try the effect of the echo, I fired a pistol, at which the hag fell flat in squeamish nervousness. A fool, who wanders in that region, and had come into the cave, said, 'Try a shot at the trout.' I proceeded to load, and had scarcely commenced when a dark cloud came over the sun, that had just been shining brightly, and prevented our seeing the fish that had, an instant before, been very conspicuous. I fired at random, and instantly the sun shone out again, and there was the fish with his head to the stream quite unscathed. This curious coincidence, I am sure, must have added to the faith of the country people who were looking on, and who would probably have less compunction in committing a murder than in killing one of these fish."

From this the travellers made their way to Tuam, and thence to Dublin, experiencing no greater annoyance than a miserable dinner, and the inconvenience of six in a coach, including an old woman with a *hen* under her arm!

In 1836 Mr. Ball attended the meeting of the British Association at Bristol, and there met for the first time Amelia Gresley Hellicar; to this lady, the daughter of Thomas Hellicar, Esq., merchant, of Bristol, he was afterwards married. In the spring of 1837 he had an attack of scarlatina, which left behind it so great a weakness of the eyes as to oblige him to abandon all business, and give them total rest. This he did by going for a month to his father's house in Youghal. Later in the year he spent some time with scientific friends at Paris; and, after taking part in the Liverpool meeting of the Association, proceeded to Bristol. There his marriage took place on the 21st September of that year.

A letter to his father, dated in 1837, mentions that he had been appointed one of the Secretaries of the Zoological Society of Ireland. From that time forward, during all the vicissitudes of the next twenty

years, he never slackened nor wavered in his efforts for its welfare, and for the diffusion by its means of zoological knowledge. In connexion with this Society, he delivered, in 1839, a public lecture upon Fishes and Fisheries (" Saunders' News-Letter," 24th May), dwelling particularly on the importance of fishermen being specially educated for their calling, and suggesting a mode by which, in his opinion, that education might be given. The lecture was well received; led to an extensive correspondence with Members of Parliament and other influential persons; and was in part republished in various quarters. At a later period the subject came under the notice of the Commissioners of National Education for Ireland; and they justly concluded that it would be of importance that the children of fishermen should acquire a knowledge of the fishes of our coasts, the modes by which they are taken, and the implements employed in their capture. Acting on this conviction, they were pleased to pay Mr. Ball the high compliment of applying to him, by letter dated 30th June, 1846, to furnish, for the use of their schools, a small volume on Fishing; stating at the same time that it should be written in a simple and intelligible style, suited to the capacities of children from ten to fourteen years of age, and suggesting particular points that might with advantage be introduced.

He most cordially undertook to perform the honourable task thus assigned to him; and, that nothing might be wanting on his part to execute it in the most effective manner, he determined to become an eyewitness of such methods of fishing as he had not already seen. For this purpose he went to the Pilchard Fishery at Cornwall; and was exposed there from daybreak to midnight in one of the boats, during a heavy swell, the day being calm and intensely hot. It unfortunately happened that his head was but badly protected by a light cap. Dizziness, sharp pains in the head, and serious functional derangement, followed, and affected him long afterwards. From this cause, combined with the pressure of public business, the "Fishery Book" was never completed. Returns to a series of questions were, however, procured from 198 Coastguard stations round the Irish coast; and as these, along with much additional matter, have been carefully preserved, it is to be hoped that the information which they contain may yet be made available for the purpose for which it was collected.

In 1840 he had the gratification of making a tour to Galway and Arran, with his friends, Professor Edward Forbes, Mr. W. Thompson, and Mr. Hyndman. References to this tour occur in the publications of both the first-named gentlemen. Among the letters relating to it I find one from Mr. Ball to his wife, dated Roundwood, July 24, 1840. It appeared to have been written in red ink, which by fading had lost something of its original brightness. But on reading the letter, I find it is one in every respect very characteristic of its author, for it is written in the colouring matter ejected from the Aplysia, or sea-hare, and contains, for Mrs. Ball's satisfaction, a sketch of the animal, likewise executed in the material which it had so unconsciously supplied.

The following extract from a letter dated 29th March indicates some of the subjects which then occupied his thoughts:—

To Robert Patterson, Esq.

"I am not an early riser, except under strong inducement. I feel usually so little refreshed by sleep that I find equal difficulty in getting up or going to bed." "I was only once free from the difficulty of getting up early: it was when a transient prospect opened of following out my own views of life; and I then, for four months, consumed but six hours a day in sleep, dressing, &c. My work all went for nothing, and I fell back to old habits again. During this time, when I was in earnest with life, I read twelve hours a day, and fulfilled my duties in various public offices; took sufficient exercise-time at meals, for the remaining six; and I think never was so long free from indisposition of any kind. Thus, you see, I have in myself a good example; but I lack the spur of some special object.

"New Zealand is again upon me, and two friends have been just with me on the subject. It would be painful to transport myself from cultivated minds for ever; and the eat-and-be-fed life you describe would not be according to my taste. But that proposed in New Zealand is not quite of this character. My great speculation there would be the improvement of the natives; a less profitable but more worthy object than the rearing of sheep."

Later in the year (July, 1840), Mr. Ball and I were fellow-lodgers at Plymouth, during the meeting of the British Association at that town. On one occasion we had the pleasure of visiting the Fish-market there—always a place of some interest to the naturalist—accompanied by our friends, the Rev. Dr. Robinson, of Armagh, and Thomas F. Bergin, Esq., of Dublin. We went on board the San Josef, were conducted round the dockyards, and witnessed the mechanical wonders there displayed.* We took an opportunity during our stay of having to

* Though familiar with the graphic lines of my townsman, Samuel Ferguson, Esq., entitled, "The Forging of the Anchor," I had never realized the full power of their rhythm until this day, when, after witnessing the whole process so vividly described, Dr. Robinson, on our leaving the forge, repeated part of the verse:—

"And I see the good ship riding
All in a perilous road,
The low reef roaring on her lee;
The roll of ocean poured
From stem to stern, sea after sea,—
The mainmast by the board!
The bulwarks down—the rudder gone—
The boats stove at the chains;
But courage still, brave mariners!—
The bower yet remains."

Then, indeed, I learned how precious and enduring is the radiance which the words of the poet shed over the things of earth.

row up the "Tamar;" dined at a quiet little place on its banks; and descended that noble river when the rich hues of a summer evening lighted the vessels of war that, laid up 'in ordinary,' were the peaceful occupants of its waters.

Our week at Plymouth was a joyous one. Before its close the following note was written by Mr. Ball to his wife. It is interesting as showing a frame of mind different from that which the previous letters portray, and also as affording an instance of his fertility of resource:—

"*August* 1, 1841.

"I started yesterday, at 8 o'clock, in an omnibus, containing Owen, Gray, Richardson, Fellowes, Taylor, Woods, Lankester, Winterbottom, Patterson, Ball, and two others, who got in amongst us by accident. After a journey of eighteen miles, passing through Tavistock, we reached mines of copper, tin, and lead, where the Marquis of Northampton and one hundred and fifty people were assembled. After viewing the pumping, washing, stamping, and other operations of the miners, we had a very plentiful dinner, and returned. I scarcely ever had a more pleasing day; great stores of information rolling out from the mass of fun, in the most curious, but useful manner. When it was proposed that Section D should go on a separate scamper from the others, I excited a good deal of fun by painting in green on my white pocket-handkerchief the letter D, which, fastened on a stick, was borne ahead, and kept our party together. I did it on the moment by the agency of a smooth stone and some grass, and it looked as well and as bright as if specially ordered for the occasion."

One of his letters, written in the ensuing year, glances at the variety of subjects that occupied his busy brain. Those who have known anything of the minute and searching interrogatories of his friend, Mr. Thompson, while collecting information on any subject, will understand what he referred to by the term "cross-examination."

"*April* 5, 1842.

"I have now a great deal of zoological matters on hand, this being the close of our year,—the arrangements of the lectures, evening meetings, and a treaty of alliance with the Dublin Society; besides which Thompson's cross-examinations have to be attended to; and my brains are not clear from sheep-stealing, infanticides, and other delicate subjects, which occupy my attention at the Castle."

His clerkship in the office of the Under-Secretary he continued to hold for ten years longer. There is little in that long term of official life that is pleasant to dwell upon. To him the duties appear to have been at all times distasteful, and fraught with an exhausting and depressing influence. In a letter to his friend, Mr. Dowden, he says:— "My soul-subduing slavery of Castle work leaves me sometimes without *vis* for anything good." With regard to official rank, station in society

as connected therewith, income derivable therefrom, and prospect of future advancement, he was emphatically a disappointed man. Expectations had been held out to him that had not been realized, and he was gradually led to look with a jaundiced eye on all that belonged to the routine of official duty. It was in vain that some of his friends tried to argue against this feeling; to urge that "man is born to trouble as the sparks fly upward;" that each station in life has its own anxieties; and that his brought with them countervailing advantages. The uniform reply was, in substance, however varied might be the words, "The heart knoweth its own bitterness."

The vigorous and healthy constitution he originally enjoyed could not but be affected by close confinement, over-exertion, and desponding spirits. From the good effects that even a few days' relaxation always afforded there can be no doubt that a more prolonged absence from "toil and trouble" would have been, at any time during the last years of his office life, productive of beneficial results. In the autumn and winter of 1846, the "famine year," there was a great and unavoidable increase of office work. It came upon Ball at a time when he was physically but ill fitted to bear the additional burthen; and, after continuing his efforts longer than he ought to have done, he became utterly prostrated, and was ordered by his physicians to cease altogether for some weeks from anything requiring mental effort.

There are services which are trying, responsible, and laborious, yet which have something cheering and pleasant at the close, as the murky sky is sometimes gladdened by the tints of the sunset. The close came at last, but brought to Ball no graceful recognition of official services performed, nor that provision for the evening of life that he had anticipated. In 1852 a reduction took place in the Chief Secretary's office, and Mr. Ball was placed on the retired list, on the ground that he "devoted much attention to scientific pursuits; and that it was not expedient that public servants should be thus occupied." He felt much hurt at the rebuke implied in these words, for his duties had not been neglected,—they had, according to his convictions, been faithfully and honestly fulfilled. At the end of twenty-five years' public service, his retiring allowance was now fixed at £162 per annum.

A few years prior to his being superannuated at the Castle, he had, in 1844, entered on a public appointment of a very different kind,—that of Director of the Museum in Trinity College, Dublin. This office was taken with the full approval of his superiors, Lord Eliot and Mr. Pennefather. It exercised an important influence on his future life, supplying not merely regular occupation, but occupation most congenial to his tastes and acquirements. It tasked his energies for years; but in none of his letters is it ever coupled with complaint. Of it he could say with sincerity,—"My good will is to it."

It is so rarely that Mr. Ball speaks of his own acquirements or of his private collection, that a few passages from the letter, addressed to the Board of Trinity College, in which he proposes for the Directorship, may be read with interest:—

"I have since I can remember paid much attention to the Zoology and Botany of my native isle, so much so that I have added very considerably to the Fauna and Flora of this country, and formed a native zoological collection of greater extent than any other existing. It contains many of the original specimens described as new to our island. I would propose to the College the formation of a native zoological collection as a distinct portion of their Museum, to embrace the whole range of animal life, as a matter which the advancement of science seems to require, which would reflect credit on the College, and the want of which in the kingdom is considered no small reproach in the eyes of strangers. If the matter be deemed worthy of attention, I offer, on being appointed Zoological Curator or Director, at a moderate salary, to hand over to the College *all* my Collection of Natural History, the native portion of which, as before stated, is very considerable, containing several unique specimens of birds, fishes, &c., and a series of others not to be found elsewhere, with skeletons and anatomical details, in the best possible state of preservation. The Conchological portion, including foreign shells, extends to about 2000 species, and contains specimens of nearly all the native genera, several species not to be found in the Museums of Paris or London, and is a more instructive collection than any other I am aware of existing in this kingdom."

Prior to the Museum being placed under the superintendence of Dr. Ball, the collection of minerals formed by far the most valuable, well arranged, and attractive portion. The harp known as that of Brian Boroimhe's, and the weapons brought home by Captain Cook, are among the details which those who, twenty years ago, visited the Museum will probably recollect; nor will they forget a huge, ungraceful, badly stuffed giraffe, which occupied a very prominent position. But the Museum, as it then existed, contained nothing that could properly be termed a zoological collection: not even in any one department did it exhibit that collocation of species which would instruct the student as to names; nor had it representatives of the leading groups so as to convey some general ideas of classification. A perusal of the three "Reports" respecting the University Museum (1845, 1847, 1848) will show how comprehensive were the views with which the new Director entered on his duties, and with what singular modesty all reference to changes, as *his* doings, were avoided. He refers, most properly, to several specimens which, from being "original," have thereby a peculiar value in the eyes of the naturalist. To have avoided all mention of these, because they were first made known by himself, would have been unworthy of the truthfulness of his character.

The Museum, in its present state, is one of which the University of Dublin may be justly proud. It is much to be wished that the zealous Director who has succeeded Dr. Ball would draw up a Report of the present state of the Collection in all its departments. It would be an unimpeachable record of the character and abilities of his predecessor.

In 1850 the Board of Trinity College testified what they were pleased

to term "their sense of his distinguished merits," by conferring on him the honorary degree of LL. D.

From the time that he entered fairly on the duties of his new office, Dr. Ball looked forward to making the Museum directly the means of instruction; and in the first "Report" announced his intention (when the arrangements were further advanced) "to form a class of Practical and Philosophical Zoology." "In the meantime," it added, "he will be happy to afford to students all the information in his power to aid them in any zoological pursuits they may engage in." This scheme was never carried out as originally contemplated; but, a few years afterwards, a new organization was formed, under his auspices, which succeeded in drawing together some ardent and youthful naturalists, whose zeal required not to be stimulated, but merely to be guided aright. He became the personal friend of each of its members and their much-respected President. To this reference will be made hereafter.

In 1851, on the formation of the Queen's University in Ireland, he was honoured with a request from Lord Clarendon and the Senate that he would undertake the office of Secretary. He made this known to the Provost and Board of Trinity College, and, after consulting them on the subject, he, with their full approval, accepted the highly flattering proposal.

Of the nature of the varied and responsible duties in connexion with this appointment, no one not a member of the Senate, is competent to speak. Their opinion on the subject was afterwards expressed under circumstances that gave a peculiar solemnity to the act.

In the autumn of 1854 he was requested to act as Secretary to the Joint Committee of Lectures. That Committee was appointed under the Department of Science and Art, and consisted of eight members, four on the part of Government, and four on the part of the Royal Dublin Society. The matters which came under its control were of a twofold nature,—first, Lectures common to the Royal Dublin Society and to the Museum of Irish Industry; and, secondly, Provincial Lectures and Examinations throughout Ireland. The subjects were classed under the three general heads of Natural History, Chemistry, and Natural Philosophy, each of these being divided into departments. Dr. Ball took a warm interest in the success of these lectures, seeing in them a powerful means of diffusing over Ireland some elementary knowledge of several important branches of physical science. No salary was originally attached to the office of Secretary, for the very sufficient reason that no one could predict what possible amount of duty he might be called to fulfil. On his death, however, his faithful and able services were acknowledged, and some compensation for them transmitted to his widow.

In 1855 he was employed as Assistant Examiner for Ireland to the Civil Service Commission, and continued up to the period of his death to fulfil, with acknowledged ability and impartiality, the duty confided to him. It involved the necessity of answering great numbers of letters from the several candidates and their friends, and many from gentlemen personally known to himself, who sought to interest him on behalf of

some particular candidate in whose success they felt interested. All information that he, as a public man, could give was imparted promptly and courteously. Beyond this he was utterly unapproachable: he feared not frowns, and he sought not favours.

In his letters to me he mentions from time to time the addition to his income from these several sources. To him the increase brought comparative affluence, and this happily at a time when the educational expenses of his children were necessarily on the increase. His habits had never been extravagant; but, with a wife and youthful family dependent upon him, there existed strong reasons for a consistent and judicious economy. While those men of science, from the sister country and from the Continent, who called upon him, experienced his unostentatious hospitality and kindness, he was never tempted to pass beyond the limit that prudence prescribed. Hence, though he felt for many years that his income was a restricted one, he never experienced the miseries attendant upon debt. There was no man, therefore, whom he feared or felt ashamed to meet; nor was his self-respect ever impaired by those unworthy subterfuges which are resorted to by those who are possessed of less self-denial. This is a rock on which the man of literature or science too oft makes shipwreck of his freedom of thought and his integrity of action. The avoidance of it seems deserving, therefore, of special mention.

It was acting in perfect conformity to these principles that, instead of having at his house the entertainments known as evening parties, he had reunions on a larger scale, when the attractions were solely of an intellectual character. At these conversaziones tea and coffee constituted the only refreshment; and thus, for an outlay utterly insignificant, he would receive an assemblage of perhaps 150 persons of the highest intellectual and social eminence which the learned or fashionable circles of the city could furnish. The arrangements were always excellent, and each conversazione had its own peculiar novelties to furnish food for comment or inquiry. To be invited was considered as an acknowledgment of intellectual gifts of some kind or other; and this circumstance, with the pleasures which the evening afforded, always made the invitations not only willingly accepted, but even to some extent desired and sought for. It was a pleasant and cheering spectacle to see him receiving as his guests noblemen and courtiers, the heads of the Church and of the Bar, of the Army and of the Medical Profession, of our Irish Universities, of the principal scientific societies in Dublin, and such strangers of literary eminence as might chance to be then in town.

He had occasionally an assemblage of a very different kind, which, if less brilliant, was not less animated,—a children's party. His little guests, on entering his rooms, soon felt at their ease, and turned in real earnest to enjoy themselves. But never did the "fun grow fast and furious" until Dr. Ball entered into their pastimes, and took part in all that was going forward; and so taking was the example, that some of his confreres, who elsewhere have sat as the learned Presidents of Sections, have on such occasions flung gravity aside, and joined heart and good-will in the uproarious merriment of the hour.

On one of these occasions Professor Edward Forbes, attired in a flowing wig and crimson dressing-gown, delivered a lecture, replete with genuine humour, on a new species of Chimpanzee, represented by Ball in a mask or head-piece and dress of bear-skins, prepared by himself, and adapted to the purpose. At the end, the Chimpanzee, after flinging off his paws and then his hind-feet, leapt among his auditors, and put them to flight, amid uproarious merriment.

Such things as these bear witness to the kindly and social dispositions of the man. Science guards from decay the smallest particles of gold added to her stores: they remain there for future generations; but the genial qualities which endear man to his fellows, and make him a participator of the happiness of children, belong to the present, not to the future, and when their possessor has passed away, live only in the memories of those with whom he was associated.

Much of Dr. Ball's mental activity was expended in connexion with various scientific societies. He acted as local Secretary for Dublin of the Botanical Society of Edinburgh, and the Ray Society, London. It was, however, in those properly belonging to Dublin that he was most valued, for there the respect which attached to his moral and social qualities made him a useful and influential member, irrespective of the special range of subjects for which a society had been founded. To this Professor Oldham alludes in a note addressed to myself. It was written after the Dublin Meeting of the Association in 1857, in reply to a request that he would favour me with some recollections of our mutual friend as connected with the Geological Society of Dublin:—

"I need not say to you how completely Ball's aid and help were felt here in the little every-day and every-hour intercourse of men mutually engaged in the same great object, rather than in any larger effort of his. Of his value as a friend, of his sincerity as an adviser, of his eartnestness as a helper, of his conscientious uprightness as a workman, I need not say a syllable. These are all better known to yourself than to me, though not more highly appreciated."

The following are the notes for which I am indebted to the kindness of Professor Oldham. I rejoice that his brief visit to these countries permitted the application to be made to him; and I hope that when these pages meet his eye, under the scorching heat of an Indian sun, he may be assured that many a heart will respond to what he has written, and thank him for it.

"Robert Ball was an early member of the Geological Society of Dublin, having joined its ranks in 1835, about two years after its first formation. From that time until his death he continued uninterruptedly connected with the Society, and was an active and zealous member. In 1837 he was elected a member of Council, on which he continued to serve for years. In 1843 he passed into the rank of Vice-President of the Society, and in 1852 he became President. He was throughout a steady and active supporter of the Society, and one of the most regular attendants at its meetings. He was a useful aid in obtaining for the Society the use of the rooms which for many years it occupied in the Custom-

House, Dublin, when its own funds were not sufficiently flourishing to enable it to rent rooms for its own occupation. Subsequently he was one of the principal supporters, if not the originator, of the proposition which was afterwards carried out, that the Society should offer its collection to the University of Dublin, which had for some years previously been taking a most praiseworthy interest in the Natural Sciences. As a fellow-worker with him for many years, I can testify to the untiring zeal with which he entered into every plan for the advancement of the Society, and to the truly disinterested and active aid he afforded in carrying them out. During the many years I was Secretary, and afterwards President, of the Society, Ball was one of the great supporters of the institution, and through good report and evil report he never failed in his confidence in its final success, or wavered in his steady adhesion to its ranks. The Journal of the Society contains a few contributions by him, bearing principally on the light thrown on geological questions by natural history research among living animals; and it was but a just and proper acknowledgment of these long-continued services which the Society gave expression to in his election to the Chair."

"In the internal management of the Society his friendly and social intercourse with most of the members was of great avail. It was chiefly by his persuasion that the Council adopted the plan of meeting at breakfast, a plan attended with the most beneficial results, and still continued with great success. Dr. Ball's purely geological work was not much; but on this, as on every other subject with which he was acquainted, we all felt, and acted on the feeling, that we should in no case apply to him without being certain of obtaining from him every information that he himself possessed: and this was always given with the most perfect frankness and the most friendly earnestness."

The Geological Society of Dublin was founded in 1831; the Natural History Society seven years afterwards. Of the latter I find no mention in any of Dr. Ball's papers that came into my hands; and for the following particulars referring to it I am indebted to the kindness of its excellent Honorary Secretary, William Andrews, Esq. This gentleman informs me, that the first meeting of the Dublin Natural History Society was held on the 19th March, 1838. At its third meeting, in April of the same year, Dr. Ball and W. Thompson, Esq., were elected Honorary Members. Dr. Ball afterwards became an Ordinary Member, and as such was placed on the Council. He does not appear, however, to have read papers or taken any active part in the management, and his name was afterwards removed. In the session of 1841–42 Mr. Andrews was elected one of the Secretaries in the room of Mr. Clarke, who retired on his ordination. Mr. Andrews was desirous of introducing certain changes tending to elevate the character of the Society, and he was also anxious that the names of Dr. Scouler and Dr. Ball should be placed on the Council. Both were rejected. From that time Dr. Ball never interested himself in the proceedings of the Society.

The Statistical Society was established in 1847: Dr. Ball was one

of its Council from that period until his death; but did not read any papers, nor take any active part in its proceedings.

Of the Society referred to at page 22, he was emphatically *the* founder, and by every means in his power endeavoured to aid its advancement. It was originally restricted to Zoology, but afterwards extended its range, and became known as the Dublin University Zoological and Botanical Association. From his Address as President (November 16, 1855) we learn that the Association was founded early in 1853, with the gracious approval of the Provost and Board of Trinity College. In that Address, after lamenting the death of several fellow-workers, he directs the attention of the members to branches of inquiry with which he had to some extent been occupied. Among them are local and Irish names of species, and remains of extinct mammalia found in bogs; dredging; excursions; observations of periodical phenomena; collection and preservation of specimens; uses of museums; comparative anatomy; reasons for studying zoology, and the practical applications of zoological knowledge.

When a President can speak from his own knowledge and experience on topics such as these, and addresses a society of young and energetic spirits, satisfactory results are sure to follow. The seed falls on good soil, and will bring forth fruit abundantly. Such is the respect in which he was held by the students who then gathered around him, such the influence of his example, that it may with truth be said, that he yet continues to teach, and that the meeting-room, No. 5, Trinity College, is still redolent of his presence.

Through the kindness of Edward Clibborn, Esq., of the Royal Irish Academy, I am enabled to give the following particulars:—

Dr. Ball became a member of the Academy in the spring of 1835, and was elected a member of the Council, in the Department of Science, in March, 1838. On the 15th March, 1845, he was chosen Treasurer, and continued to hold that office up to the period of his death.

The value of his services was felt in all that was going forward, and in the suggestions and remarks that he threw out on the various subjects that came under the notice of the Academy. Among his communications may be mentioned those—

"On the Species of Seals, Phocidæ, inhabiting the Irish Seas." "Transactions," vol. xviii., p. 80.

"On the Remains of Oxen found in the Bogs of Ireland." "Proceedings," vol. xv., p. 253.

"On a Species of Loligo found on the Shore of Dublin Bay." Nov. 30, 1839.

"On a Species of Sturgeon (*Accipenser Thompsoni*)." "Proceedings," vol. xxv., p. 21.

"On the Cephalopoda of the Irish Seas." "Proceedings," vol. xxxii., p. 192.

"Notes on Acetabuliferous Cephalopoda, including two new species of Rossia." January 10, 1842.

"On the Fœtus of the Spined Dogfish (*Acanthias vulgaris*)." April 27, 1846.

"Notice of the Structure and Position of the Nostrils of the *Apteryx Australis*." May 25, 1846.

"On the Fossil Remains of Bears found in the Bogs of Ireland." Dec. 10, 1849.

"Remarks on the Periods of the Bones of the Irish Elk, and other Animal Remains." Nov. 29, 1851.

His papers or communications were not limited to zoology, but extended at times to those which belonged to antiquarian research. (*Vide* "Proceedings," January 8, 1844; February 12, 1844; January 13, 1845; December 11, 1854.)

Dr. Ball was elected a Life Member of the Royal Dublin Society in 1834; but did not regularly take any active part in its proceedings. In 1854 he became a Member of Council. His co-operation, at all times, was highly valued.

I had on many occasions during the last few years urged Dr. Ball to give up one, at least, of his public appointments, and to retire from the Council of all Societies save one or two. I argued that such a course would conduce greatly to his own personal comfort, and would give him leisure to work, with greater effect, in a narrower circle. But he replied, that his being associated with so many bodies was in itself productive at times of good results; that it rendered mutual co-operation more easy, and prevented the jarring of separate interests. The arrangements made between the Royal Dublin Society and the Zoological (adverted to hereafter) may, perhaps, afford proof that the opinion of my lamented friend was not unfounded.

Of all the Dublin Societies of which Dr. Ball was a member, the Royal Zoological Society, founded in 1830, was that with which he was most pre-eminently associated. It was there that he acted, for more than twenty years, as an Honorary Secretary, devoting to it "a large portion of valuable time, and the energies of a strong and cultivated understanding."

He had able and influential coadjutors in the officers and Committee. Gradually, as they saw that he laboured with singleness of purpose for the interests of the Garden, and became assured by experience that his plans were both judicious and comprehensive, they sanctioned his proposed measures, and devolved on him their responsibility.

Seldom were they disappointed in the results: the work was not only done, but done well, and in a way peculiar to himself. Every part of the Garden bears witness to his ingenuity, and to his anxiety to accomplish his object with the least possible expenditure. No less obvious is the desire to make the collection not a mere show for visitors to gaze at, but a school in which the elements of zoology might advantageously be studied.

The members of the Council of this Society refer affectionately to Ball as one to whom they were indebted for much that has been of service,—as the establishment, in 1844, of the weekly breakfast at the

Gardens, at which many of their plans are discussed, and the business of the Society transacted, while at the same time a kindly and social entercourse is maintained among the members who, for the time being, have the guidance of its affairs. To his efforts they owed, in a great degree, the splendid present of the Giraffe in 1847, from the Zoological Society in the Regent's Park, London. To his untiring labours and rigid economy they mainly attribute the preservation of the collection in the Garden, during the dread visitation of the famine in 1846 and 1847.

There are two circumstances connected with this Society, which deserve a special mention, though necessarily brief: first, the establishment of the zoological lectures; and secondly, the penny admission to the Gardens for the working classes.

The lectures commenced in the year 1838, and were eminently successful. For some years many of the most distinguished individuals in Dublin took part in them; much interest was manifested in the subjects brought forward; and a large accession to the funds of the Society accrued. Dr. Ball himself gave a hearty co-operation, and delivered five lectures, which appeared in Saunders' Newsletter; one of those was that referred to (*ante*, p. 17); the others were on "Sloths," on "Birds," on "Electrical Fishes;" and in the winter of 1840, a resume of those previously delivered during that season. Some of those lectures he prepared with great care, and rendered them highly philosophical, though popular, expositions of the subjects discussed.

The penny admission on Sunday after 2 o'clock was first instituted in 1840. In 1855 the same privilege was extended to visitors to the Garden after 6 o'clock in the summer evenings. The Reports of the Council give us the exact number of penny admissions in each successive year, and is the best proof of their importance. From the fifteen years, from 1840 to 1855, the average annual attendance was 75,450! Who can estimate the amount of harmless pleasure that has thus been diffused among the humbler classes of a populous city; or the information imparted, and the craving for further knowledge inspired; or the intemperance averted; or the blessed influences called into activity, when the members of a toiling family partake of a pleasure which tends to elevate and to refine?

It was a great source of satisfaction to Dr. Ball that the arrangement by which the Royal Zoological Society was to receive £500 a year from Government, to be paid through the Royal Dublin Society, was effected. It not only gave to the Zoological an assured stability, a certainty of income, but it was the public recognition of a principle as yet but imperfectly acknowledged, that the study of Zoology is worthy of support from the public funds of the nation.

The subject of Educational Zoology, and its intellectual and moral influences, was adverted to by Dr. Ball and others on several occasions in the courses of lectures delivered before this Society. It was one that he had much at heart, and which I find often mentioned in his letters. He wished the rudiments of the study to be universally introduced into

schools, and the science, in its higher grades, to form a regular part of the curriculum of our Colleges. His wishes were in part fulfilled, and he had, in more than one capacity, the high gratification of aiding in their advancement.

In connexion with this subject should be mentioned his views for the improvement of our fisheries. The first step, in his opinion, was to give a special education to the fishermen themselves. He considered that a knowledge on their part of the habits and economy of fishes, and of the creatures on which they feed, was indispensable; and he therefore urged that the aid of zoological science should be secured so as to make our fishermen thoroughly acquainted with their calling, and to render the fisheries themselves productive and profitable.

A passing reference has been made to the ingenuity apparent in the structures erected in the Zoological Gardens, and in many of its arrangements. The tent-like house for the splendid specimen of the Plesiosaurus, the plan of the building containing the aquatic vivaria, and the simple method employed for aërating the tanks, are obvious examples. Fertility of device was one of Dr. Ball's mental characteristics, and it was continually manifesting itself in a great diversity of forms. It was, in fact, a very Proteus in its aspect. At one time it was a plan to prevent the evaporation of spirits from glass vessels; at another, that of securing to his capacious fernery a regular supply of moisture. To-day it was the making of a naturalist's dredge, so efficient that it was used by Edward Forbes* in the Ægean; to-morrow it was the restoration of the Harp of Brian Boroimhe† by the collocation of its severed portions. Among his many inventions was the use of naptha as the medium for colours to be used for zoological diagrams. He found by this plan the drawings could be executed much more rapidly, and that they possessed an increased brilliancy of colour. In 1849 he communicated this to Mr. Tuffen West, the eminent artist, who chanced at that time to be resident for a few weeks in Dublin. That gentleman tried the plan, and has given the highest attestation in his power of its merits, by using it in the execution of most of the natural history diagrams for the Queen's Colleges of Galway, Cork, and Belfast.

As an example of Dr. Ball's readiness of resource, the following circumstance may be worthy of record:—

The writer of the present memoir had undertaken, at the request of the Commissioners of National Education in Ireland, to deliver, at Marlborough-street, in November, 1845, a short course of zoological lectures to the male and female teachers then attending their classes. He had occasion to speak of the sea-jellies, sea-nettles, or jelly-fishes, as they are termed; and, recollecting that many of his auditors were

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* A letter to a friend from the late Professor Forbes, written when engaged with Captain Graves in the Ægean, says, in speaking of the results he attained, "Tell Ball that but for his dredge this could not have been accomplished." It is described in Harvey's excellent "Sea-side Book."

† A description of this harp was printed by Dr. Ball.

from the interior of the country, and had probably never seen one of these animals, he felt some doubt as to how he could convey to them an idea of their jelly-like appearance. In summer the shore of the bay would have supplied thousands of illustrative specimens, but they were not available in November. What was to be done? He told his difficulty to his friend Ball, at whose house he was then staying, and he at once replied, "I'll make you a jelly-fish!" and a capital one he did make. From Mrs. Ball's store-room he brought something which, when boiled, furnished a transparent gelatinous substance. Whilst it was boiling he cut from the purplish linen covering of one of the children's school-books four pieces which represented the peculiar markings of the most common species (*Aurelia aurita*), poured out the gelatine into a saucer, placed the purplish cuttings in their proper relative positions ere his cookery had "set;" and thus in an hour he produced an impromptu jelly-fish, which answered admirably well the purpose for which it was intended.

He afterwards, by a mixture of gutta-percha and treacle, succeeded in making casts of the more common star-fishes, and these, when coloured after nature, formed excellent representations of the originals. As such, a series of them would have been very useful for school museums, especially as they had a certain degree of flexibility, and might be handled without being injured or broken.

Any one who has been for some years taking an active part in the management of public societies of any kind will call to mind occasions when some question of moment divided the opinions of its members, and gave rise to animated discussions. When such questions sprung up, Dr. Ball never shrunk from the advocacy of his opinions, no matter what obloquy might attach to them, or how few might be the number of his adherents. In all such cases, "when the battle's lost and won," it is best to let its heat and its excitements pass away. But, unfortunately for Ball's peace of mind, it was not in his nature altogether to do so. He was keenly sensitive to any remark that he regarded as untrue or unkind. To most men these "paper bullets of the brain" would have caused no annoyance; with him it was different. The shaft might be a light one; but if it struck him at all, the barb was difficult to extract, and left a scar behind.

For the last three years of his life his letters to me were much less frequent than formerly. He was, in fact, too much engaged to write anything that he could well avoid. His usual period of recreation was from 1852 abandoned, and, in point of fact, never did he slave so hard as when he was freed from the necessity of attendance in the Secretary's office. During his Castle-life there were six weeks of holiday, which the regulations of the office sanctioned, and which he spent in visits to Youghal and other excursions. The bow which had for many months been kept in a state of tension was then unstrung, and regained in a great degree its natural elasticity; but after his appointment to the College Museum a great change took place. These precious holidays were set apart for Museum work, and the health-giving period of relaxation was

abridged or abandoned. When other public appointments were subsequently added, he strove zealously to perform their duties, and most efficiently he did so; but he attained his end by giving up leisure, recreation, and bodily exercise. Nature enforced, as in all such cases, a heavy penalty for the neglect of those observances prescribed by the laws of health.

It was in vain that friends in the country wrote and pressed him to come to them on a visit, holding out such attractions as their different localities offered. He thanked them, accepted their invitations; but deferred his going until "a more convenient season." That season never came. The deaths of several eminent naturalists during the last few years, some of whom were among his most valued friends, were at times much in his thoughts, and were spoken of in pathetic terms.

At the beginning of February, 1857, I was his guest for a few days, and thought he was looking particularly well, though complaining of sleepless nights. We were present at the conversazione given on the 4th of February by the President of the Royal Irish Academy. We went together, one forenoon, to call on Dr. Harvey at his rooms in College. In the ante-chamber the portraits of Forbes, Thompson, and other naturalists were on the walls. As we passed along, Dr. Ball stopped, pointed to the portraits of his deceased friends, and simply said, "Who next?" Before the ensuing month was ended, the question had been solved.

He had been apparently in his usual health, when, on the morning of Friday, the 27th of March, he was suddenly seized with symptoms of an alarming kind. The illness, after assuming phases which for some hours renewed the hopes of his family, terminated fatally on the evening of Monday, the 30th. A post-mortem examination, held in conformity with his own express instructions, showed that the immediate cause of death was rupture of the aorta.

The funeral took place on Friday morning, the 3rd of April, in the cemetery of Mount Jerome. The Royal Irish Academy, in its corporate capacity, took part in the mournful procession, the mace, enveloped in crape, being borne before the President.

The members of the Royal Dublin Society and of the Dublin University Zoological and Botanical Association were specially invited to attend by notices sent out by their respective Secretaries.

In the brief interval between his death and his funeral many warm-hearted friends had been pondering in what way they could best testify their regard for him who had been removed from among them; but to the Board of Trinity College must be conceded the honour of being the first to adopt a line of conduct which would mark their respect to the dead, yet not wound the delicacy of the living.

On the same day that his remains were consigned to the grave the Board met, passed a resolution granting to his widow an annuity for life, and had this communicated to her in the kindest and most considerate manner.

On the ensuing morning the Council of the Zoological Society assembled as usual at the "Gardens," and adopted a course which testified their conviction of the loss they had sustained by Dr. Ball's death, and

their solicitous regard for the feelings of the survivors. They determined on establishing a "Memorial Fund" expressly for the benefit of his children, and communicated this decision to Mrs. Ball, accompanied by expressions of their deep sympathy for her bereavement.

Among the Minutes passed by different bodies with which Dr. Ball had been connected, and which testified in various ways the estimation in which he had been held, none was more grateful to his family than the following from the Senate of the Queen's University, and which was transmitted in the kindest manner by the Lord Chancellor Brady, Vice-Chancellor of the University :—

"At this, their first meeting since the melancholy event of the death of their late Secretary, Dr. Robert Ball, the members of the Senate of the Queen's University desire to record upon the Minutes of their Transactions their deep sense of the loss which the University has sustained in being deprived of the services of a gentleman who was, both in his public and private character, so highly valued and esteemed.

"In the discharge of his duties to the Senate and to the Queen's Colleges, of which it is the head, Dr. Ball displayed the most anxious and zealous solicitude for the interest and welfare of those institutions, and the most patient attention to every detail of business intrusted to his management, while he brought to the exercise of all the functions of his office, and faithfully devoted to the service of the University, the energies of a powerful, well-ordered mind, richly stored with scientific and literary acquirements.

"The Members of the Senate further desire to convey to the widow and family of Dr. Ball this expression of their opinion of his merits and of their regret for his loss, together with their sincere condolence with her and them in the severe affliction with which they have been visited; and they request the Vice-Chancellor will transmit to Mrs. Ball a copy of this Minute."

On the 2nd of April, 1857, the Royal Dublin Society passed the following resolution :—

"Resolved,—That the late lamented death of our esteemed member of Council, Robert Ball, LL. D., is an event calling for the marked sympathy of the Society; that the Members take the present opportunity of recording their regret at his loss and their respect for his memory, as well on account of private worth as of his varied acquirements, and the great zeal and assiduity he displayed in the numerous scientific occupations in which he was engaged, particularly evidenced by his successful superintendence for many years of the Royal Zoological Society."

The following resolution was passed at a meeting of the Geological Society of Dublin on the 8th of April, 1857, amid the deep regrets of the Society for their lost associate, and their warm sympathies for his family and friends :—

"The Geological Society of Dublin desire to express their sense of the great loss they have sustained, in common with many other of the scientific societies of Dublin, in the death of Dr. Ball, their former Secretary, Vice-President, and President. They wish at the same time to

record their high estimation of his ability and attainments as a man of science, and his character as a gentleman, and of the great services he had formerly rendered to the Society."

The Royal Irish Academy, the Dublin Natural History Society, and the University Zoological and Botanical Association, adjourned their meetings in testimony of their regret for his loss, and of their respect for his memory.

Dr. Ball had been nominated President of the Natural History Section of the British Association for the Dublin Meeting, August, 1857. The members of that Section (D) commenced their proceedings by passing a resolution akin to these already given, and concluding with the words, "that this tribute of marked respect to his memory is due not merely on account of his great merit as a naturalist and promoter of science, but much more to his personal character, as a kindly, high-minded, and honourable man."

After giving, as has been done, these testimonies to the character and attainments of Dr. Ball, it is considered unnecessary to republish the obituary notices that appeared in the local journals, or in the "Athenæum," the "Literary Gazette," and other periodicals in Great Britain.

Dr. Ball was most willing at all times to communicate his information to those who sought it; and this, combined with his equable temper and amiability of disposition, rendered it a pleasure to hold intercourse with him on points of zoological research or observation. His papers on the Hedge-hog and the Frog, published in the "Irish Penny Journal" in 1840 and 1841, evince his desire to disseminate a knowledge of what is true regarding the structure and habits of animals respecting which many erroneous opinions are yet current. His contributions to some of our standard zoological works are acknowledged by their authors, Professor Bell, Mr. William Yarrell, and Professor Edward Forbes. But it was in the long series of papers published by his friend, the late William Thompson, Esq., that Dr. Ball's extensive knowledge of the Irish Fauna was particularly manifested. These papers, with additions, were afterwards collected by Mr. Thompson, and in part prepared for publication, under the title of "The Natural History of Ireland." Three volumes, treating of the Birds, were published during the lifetime of their lamented author; the fourth volume, which appeared in 1856, was a posthumous publication. Throughout its pages, the name of Dr. Ball is of continual recurrence; and he not only gave his valuable aid to its revision as it passed through the press, but contributed additional information, which is appended as foot-notes.

"Cast thy bread upon the waters," would seem to have been Dr. Ball's motto, so desirous was he at all times to impart the knowledge which he by ceaseless diligence had acquired. He not only freely gave from his accumulated stores, but he inspired others with an impulse for the further diffusion and advancement of science. That impulse yet survives, and will assuredly produce good results, though they may not be manifested until "after many days."

The community in which he lived lost by his death a worthy citizen; yet his name will long be remembered beyond the circle that included his personal relatives and friends.

The hard-working mechanic and the toil-worn clerk shall in future years visit, with their families, the Zoological Gardens, as they do now. When enjoying amid its attractions the innocent prattle of their children, such men will naturally ask, "To whom do we mainly owe the existence of this Garden, and the penny admission, which makes it available to us?" Let some simple inscription, some unostentatious tablet, answer the inquirer, and tell to him and to his children that the name of their benefactor was Robert Ball.

Reviews.

1. The Last of the Arctic Voyages, &c. &c., by Captain Sir Edward Belcher, C. B., in search of Sir John Franklin, during the years 1852–53–54. With Notes on the Natural History by Sir John Richardson, Professor Owen, Thomas Bell, J. W. Salter, and Lovell Reeve. London: L. Reeve. 1855.

2. Reminiscences of Arctic Ice-Travel in Search of Sir John Franklin and his Companions. By Captain F. L. M'Clintock, R. N. With Geological Notes and Illustrations, by the Rev. Samuel Haughton. Dublin: Journal of the Royal Dublin Society, Vol. I. 1857.

3. A Letter to Viscount Palmerston, K. G., from Lady Franklin. London: J. Ridgeway. 1857.

4. Renewal of the Search for the Franklin Expedition. By Clements F. Markham, Esq., formerly of H. M. Discovery Ship "Assistance." Dublin Meeting of the British Association. 1857.

In giving a title to his book, Sir Edward Belcher appears to have entirely disregarded the verdict passed by public opinion upon the expedition of which he unfortunately had the command; as the most imperfect and unsatisfactory of all the Arctic searches after Sir John Franklin and his companions in misfortune. He was himself so satisfied with his performance that he does not hesitate to pronounce it to be the last and final effort to lift the dark veil which shrouds the fate of Franklin and Crozier, and their brave companions. It is to be regretted that the British Government have declined any further responsibility in this matter, and have decided that Franklin's fate is known, because a few spoons, buttons, clasp-knives, and personal decorations,

belonging to Franklin or his party, were given or sold to Dr. Rae by the Esquimaux, who, in all probability, had either murdered the owners, or obtained possession of their spoils by plundering the deserted vessels. Not a line, nor chart, nor memorial of any value, has reached us of that gallant band of 135 bold British sailors, who went forth in the Erebus and Terror in 1845, on a scientific mission to the Arctic Seas, in obedience to the orders of the British Government. It is, no doubt, probable that they have all perished, and have rendered their account to Him who is as near to the sailor in his hour of need as to the landsman; but it is equally probable that their vessels have not perished with them, and that, in accordance with the practice of Arctic sailors, the records of the expedition, or copies of them, exist buried in the neighbourhood of the ships.

We maintain that it was the duty of our Government to search, and search again, until successful, for the authentic records and traces of these gallant men, who perished as truly in their country's service, as if they had met their fate by the bullet of the Russian, or the knife of the Sepoy. Three expeditions, as our readers are no doubt aware, were despatched by the Government in search of Franklin through Lancaster Sound, commanded by Sir James Ross, Captain Austin, and Sir Edward Belcher, respectively; while three other parties under Captains M'Clure and Collinson by Behring Straits, and Dr. Rae by land, have almost exhausted the area of search, and so reduced the limits within which the Erebus and Terror must lie, as to render the refusal of the Government to look for them quite inexplicable.

The following brief account of these expeditions was given by Mr. Markham, himself an Arctic sailor, to the Dublin Meeting of the British Association last summer:—

"In 1849, Sir James Ross searched part of the eastern shore of what is now called Peel Sound, going over 990 miles. Captain Austin's expedition, in 1851, carrying on its search towards the points to which Franklin's instructions directed attention, carefully examined the whole of the southern shores of the Parry Islands, a considerable tract of coast line south-west of Cape Walker, and part of the west coast of Peel Sound—in all, 6087 miles. In 1853–4 Sir Edward Belcher's officers completed the search up Wellington Channel and along the northern shores of the Parry Islands; while in Captain Kellett's expedition M'Clintock and Mecham, in their unrivalled journeys, explored the western shores of Melville Island, and the large Islands of Prince Patrick and Eglinton, which, including the journeys of Lieut. Hamilton and Captain Kellett's other officers, makes 9432 miles. From the side of Behring's Straits Sir Robert M'Clure achieved the discovery of the North West Passage, and examined the shores of Banks' Island, and the whole western and north-western coast of Prince Albert's Land, 2350 miles; while from the same direction Captain Collinson penetrated along the coast of North America to Cambridge Bay, and Dr. Rae previously explored the same coasts in a well-directed land journey of 1030 miles. Thus, by unceasing efforts a coast line of more than 21,500 miles has been examined, of which upwards of 5780 was previously undiscovered land, and the search for traces of the missing expedition has been contracted within that small space bounded by the western shores of Boothia, King William's Land, the southern part of the shores of Peel Sound, the coast near the mouth of the Back River; and, above all, the space occupied by a deep inlet, or supposed strait, from Osborn and Wynniatt's Furthest, to Victoria Channel. This little space becomes the more deeply interesting, because not only every other possible place has already been

searched without success, but traces have actually been found at the mouth of the Back River, which only make us eager to know more, while scarcely any vestiges have been discovered elsewhere. I was myself present when the first traces were found in 1850, being a few things left by one of Franklin's shooting parties on Cape Riley. We know, also, that the Erebus and Terror wintered at Beechey Island in 1845–6, but no record was found there, save the neatly cut epitaphs over the graves of three of the men—epitaphs which almost seem to speak to us as the last words of those missing heroes who were so soon themselves to meet a glorious death in their country's service—'Choose ye this day whom ye will serve.' Then, in 1851, Dr. Rae picked up, at Parker Bay, a piece of flag-staff, with white line, bearing the Government mark, and a piece of oak three feet long; and Captain Collinson, in 1852, found a fragment of a door-frame on the Finlayson Islands. At length, a report arrived from Dr. Rae in 1854, who was then exploring the country between Repulse Bay and Castor and Pollux River, which proved that a party had travelled from King William's Land, and perished in the mouth of the Back River, about May, 1850. He procured from the Esquimaux, who gave this information, silver belonging to no less than nine of the officers of the Erebus and Terror, part of a watch belonging to another officer, and several other articles. The subsequent search of Messrs. Anderson and Stewart, at the mouth of the Back River, in 1855, proved beyond a doubt that a travelling party from Franklin's ships had reached that desolate spot."

The Government having done so much, has now stopped short, and refused to permit any further expense to be incurred in searching for the ships and documents which would throw the fullest light upon the fate of the lost expedition.

It has been, therefore, reserved for the untiring energy and womanly faith of Lady Franklin to attempt the completion of the unfinished though almost perfect search, and she has found in the author of the "Reminiscences of Arctic Ice-Travel," Captain F. L. M'Clintock, an officer alike competent and willing to undertake the command of the last and final voyage of search.

In Mr. Markham's words:—

"M'Clintock has gone forth, single-handed, to complete the search for this most heroic body of men, with the determination of clearing up the mystery which has so long hung over their fate, and crowning his long and weary labours with success. The exertions of this gallant officer, whilst serving in the various searching expeditions, have been unceasing. When Sir James Ross sailed in 1848, M'Clintock was with him, and accompanied him in his long travelling party; when Captain Austin sailed in 1850, M'Clintock formed part of the expedition, and, improving on his former experience, performed the longest sledge journey that had ever been attempted in the Arctic regions; and when Captain Kellett sailed in 1852, M'Clintock, with untiring zeal, still continued to search, and surpassed himself in his wonderful journey along the north shores of Melville Island and Prince Patrick's Island. On the 1st of July of this year he again sailed from Aberdeen on board the Fox, a vessel fitted out by Lady Franklin, assisted by the friends of this noble undertaking. The Fox is a screw steam yacht, of 320 tons and 30 horse-power, admirably adapted for the service: she is rigged as a three masted schooner, with fore-topsail reefing from the deck; she is 132 feet in length over all, diagonally built, and expected to go six knots under steam when deep, stowing two and a half years' provisions, and five weeks' fuel for full speed. A young merchant captain, named Allen Young, goes out as sailing master; and, besides his unpaid services, has contributed the munificent sum of £500 towards the expenses of the expedition. Lieutenant Hobson, R.N., late of the Rattlesnake in Behring's Straits, Dr. Walker, the surgeon, and Petersen, the Esquimaux interpreter who was with Dr. Kane, with a crew of thirty men, complete her complement. It is intended that much of the travelling shall be performed by dog-sledges, and thirty dogs will be procured in Greenland. All the travelling equipments are to be of the lightest possible material, and the sledges drawn by men are to

be reduced to parties of four. It is satisfactory to find that an officer who has searched from the very first in every expedition through Lancaster Sound, will now, in all probability, have the glory of completing this deeply interesting work, and I am certain that every one here will unite in wishing him all the success that his noble perseverance so well deserves. In this place, no doubt, especial interest must be felt in the subject now before us, for the gallant Captain of the Terror was, I believe, a native of Dublin; and M'Clure, the discoverer of the north-west passage; Kellett, who released him from his sufferings in Mercy Bay; Mecham, who has performed the longest Arctic journey on record, and M'Clintock himself, are all natives of this island."

Whilst we write, the long Arctic winter has closed in upon the Fox and her brave crew, let us hope, well down Peel Sound or Prince Regent's Inlet, ready to commence, in March or April next, those long and successful sledge journeys on the ice, which have rendered M'Clintock's name famous even among the adventurous sailors of the icy sea. He deserves success, and we believe that if, under Providence, a cool head, a brave heart, good health, and long experience, can aid him, that he will secure it. May he return in safety, with certain knowledge of the last stand of Franklin and Crozier's party, and some reliable documentary evidence of their previous explorations and fate!

The last news of Lady Franklin's expedition is contained in the following letter:—

"(Letter commenced 29th July, at sea, ended August 6, 1857.)

"*Arctic Yacht Fox.*

"My dear Lady Franklin,—On the 25th July I despatched a letter to you by the Danish schooner Neptune, then under sail for Copenhagen, in which letter I detailed my progress to that date. Briefly it was this:—Reached Cape Farewell on the 13th, after a rapid and pleasant passage of ten days from the Pentland Firth. Finding it necessary to send home one of my crew, I went into Frederickshaab, as I understood from Petersen that a Danish vessel was there. Then, on learning from Dr. Rink, the inspector of South Greenland, that another vessel, the Neptune, would sail much sooner, I proceeded to Goodbaal (Baal's river), where I arrived just in time to put my sick man and my letters on board. An accident to the Fox's topmast obliged me to go into Fiskernars for a few hours.

"I hope to get on to Lievely (Disco) to-morrow, but still have an obstinate foul wind to deal with. The prevalence of N.W. winds this spring is astonishing, and cannot but be favourable for our passage across to Pond's Bay.

"At Frederickshaab I was fortunate enough to obtain Scotch coals to complete my stock; also a good supply of fresh and most excellent codfish; our rigging is abundantly stocked with them.

"My intentions are to stop half-a-day at Lievely, then visit the coal-mine in Waigat Strait, then on to Proven and Upernavik for dogs. I will take every opportunity of writing to you. All on board are in excellent health and spirits. I have been most fortunate in the selection of my officers and crew, as also in the vessel. Our provisions are very good; indeed I cannot find out a want of any kind.

"From Beechey Island I will take an additional supply of preserved meats, and anything likely to be useful or conducive to health and comfort.

"I think you will approve of my going a little out of my way to secure an early passage home for poor Lewis; it is of vital importance to him that he should get home before the autumn weather sets in. His illness was not in any way produced or aggravated by his short coming in the Fox, and his double pay has been paid him up to September 30; indeed, he seemed to feel how much had been done for him, and I think that this proof that their health is my first care (as it is your wish that it should be so) has been appreciated by the crew.

"August 4, Waigat Strait.—We have finished coaling, and are running before a strong fair wind for Proven. We did not reach Lievely before the 31st of July, and re-

mained only a few hours. No Esquimaux was forthcoming for the expedition, but Mr. Olrick told me that there was one in Disco Fiord who would come.

"Having purchased ten fine dogs (being all I could get), I went to Disco Fiord, and there got a native, but not the one who was expected. My man is 23 years old, by name Anton Christian—is a good dog-driver, and a willing sort of creature.

"Persecuted by calms and foul winds, I did not reach the coal cliffs until last night, and now bad weather has hastened my departure, but I have filled up with coals again. The Danes have been in the habit of getting coals along these cliffs for very many years past—hence the name of 'Kulbrud,' or coal seam. I did not find or look for the part where the Phœnix was taken to by Mr. Olrick. At Lievely I saw the captains of two whalers, whose ships were lost in Melville Bay, in June. I think I shall find no difficulty in crossing over to Pond's Bay. The tablet is on board—it is very large, but being in a wooden case I have not seen it yet.*

"August 6th, 3 P.M.—Hove to off Upernavik, and about to proceed on the voyage. I have now got 30 dogs, and have only to say good-bye, and beg you will ever believe me sincerely yours,

"F. L. M'CLINTOCK."

We have been led away by the interest of the subject of Lady Franklin's Expedition from our immediate object in noticing the books and papers placed at the head of our present article; and as we have so far transgressed, we shall ask our readers' pardon for a few moments longer, before we introduce them to the rich stores of Natural History and Geology contained in the Appendix to Sir Edward Belcher's Voyage, and M'Clintock's Paper read before the Royal Dublin Society.

In Lady Franklin's letter to Lord Palmerston, a request is made that the Resolute, providentially restored by the Arctic currents, after having been *abandoned by Sir Edward Belcher's orders*, and ready equipped for Arctic service by the munificence of the American nation, should be employed to complete the nearly finished search for the Erebus and Terror. This letter was written in December, 1856, and published in January, 1857, by permission of Lord Palmerston; the noble Lord being probably not personally averse to the request being granted: however this may be, an official refusal was given to the prayer of the sailor's widow, though supported by numerous and influential naval officers and scientific men.

In the memorial to Lord Palmerston, forwarded by Lady Franklin's supporters in June, 1856, the following parallel is quoted, and is, we believe, unanswerable:—

"Now, inasmuch as France, after repeated fruitless efforts to ascertain the fate of La Perouse, no sooner heard of the discovery of some relics of that eminent navigator, than she sent out a Searching Expedition to collect every fragment pertaining to his vessels, so we trust that those Arctic researches which have reflected much honour upon our country, may not be abandoned at the very moment when an explanation of the wanderings and fate of our lost navigators seems to be within our grasp."

On the 24th February, 1857, the final refusal of the Government to aid in the search was announced in the House of Commons, in reply

* "This tablet is one which was put on board the American expedition under Captain Harstene, which was sent to meet Dr. Kane's party, in 1855, by Lady Franklin, and was left by him at Disco Island. Captain M'Clintock has taken it on to its original destination, Beechey Island."

to a motion made in favour of Lady Franklin's Expedition by Mr. Napier, Member for Dublin University.

The efforts of Lady Franklin's friends were now directed to induce the Government to send the Resolute through Behring's Straits to aid her own Expedition through Lancaster Sound.

In April, 1857, the Royal Dublin Society and the Royal Irish Academy made unsuccessful efforts in this direction. Similar exertions were also, as we believe, made in New York and Newcastle-upon-Tyne.

The memorial of the Royal Irish Academy was based upon the following grounds, which are fully set forth in the document, which has, however, never yet been published:—

"1st. It is highly probable, in the opinion of those competent to judge, that the Erebus and Terror are still in existence; and, if so, it is nearly certain that near them would be found buried copies of Sir John Franklin and Captain Crozier's Journals, and of the scientific observations made before the crews perished, which would prove of the highest scientific value.

"2nd. The locality in which the Erebus and Terror lie is easily reached, is circumscribed within narrow limits, and is in the neighbourhood of the North Magnetic Pole, which is looked upon with such interest by scientific observers. The extent of coastline already traversed by the Government searching expeditions is 6500 miles. There remain to be discovered only 370 miles. The total number of miles traversed by sledges in the former expeditions was 44,000 miles. An expedition consisting of 100 persons might be expected to traverse from 7000 to 10,000 miles, with sledges, in a single year.

"3rd. The rate of mortality for all the Arctic expeditions since 1818 (exclusive of the missing expedition) is *under* $1\frac{1}{2}$ per cent. per annum, for which, and other reasons, Arctic service is extremely popular both with officers and men.

"4th. It is not necessary for the complete exploration of the limited area of search, to penetrate so far as to risk the detention of the vessels by the ice. In the event of involuntary detention, or accident to the ships, the crews can easily escape over the ice, with sledges and boats, either to the whalers, or to one of the three great depôts of provisions stored up at Port Leopold, Beechey Island, and Melville Island.

"5th. Such danger to the ships of being crushed as exists, is annually encountered by the whalers; and out of thirty vessels employed in the late searches, only one (the Breadalbane) was lost by ice-crushing. She was only a merchant ship employed to carry provisions; had not been strengthened like the searching vessels; and had been kept in a most exposed and perilous position for fourteen days previous to the accident. This occurred near Beechey Island, where, had she been docked in the ice, in conformity with the usual practice, she would have been saved.

"6th. The scientific results of the previous searching expeditions have not been made public. Magnetical and meteorological observations of the highest interest and value were made during those expeditions; and it is manifestly unfair to decry the scientific results of those expeditions, when no opportunity of judging of them has been afforded to the scientific public, who alone are competent to judge of their value.

"7th. The commercial value of previous Arctic explorations may be judged of by the following facts:—

"1. Sir H. Gilbert's discovery of the Cod Fishery of Newfoundland.

"2. Davis—Great Whale Fishery of West Greenland.

"3. Hudson—Hudson's Bay and the Great Fur Company.

"4. Sir John Ross—Whale Fishery of the north and north-west of Baffin's Bay.

"5. Parry—Whale Fishery of Lancaster Sound, Barrow Strait, and Prince Regent's Inlet.

"6. Beechey—Whale Fishery of Behring's Straits. In this Fishery, in the space of two years the American whales obtained cargoes amounting to eight million dollars in value.

"8th. Lady Franklin's expedition affords the last hope of the discovery of a practicable north-west passage. Collinson's voyage has proved that the northern coast of the American continent can be safely navigated for an extent of 1400 miles east and west; and if there be a north-west passage at all, it must exist in the area proposed to be searched for the Erebus and Terror. It has been already proved by the set of the tides that there is a water communication in this area.

"It is proposed by Captain M'Clintock to make his way down Prince Regent's Inlet, and thence through Bellot's Strait, into the field of search; or to attack it directly, if the ice permits, by going down Peel Sound, which he has good reasons for believing to be a strait. If prevented by the ice from passing through Bellot's Strait, or going down Peel Strait, he will abandon the idea of taking the ship through the supposed north-west passage, and, leaving her in safety in Prince Regent's Inlet, will proceed to make the requisite search for the Erebus and Terror by sledging parties, so successfully used in the late expeditions, and in conducting which Captain M'Clintock particularly distinguished himself."—*Proceedings of the Royal Irish Academy.*

To this Memorial, as to the previous applications, nothing was received in reply but the usual civility of a polite refusal; and at the same time, with most unpardonable inconsistency, the Admiralty gave permission to M'Clintock to take the command of Lady Franklin's Expedition through Lancaster Sound. The gallant band of volunteers who man the Fox are now, we hope, within easy reach of the lost Erebus and Terror, and may be expected home with the broken-up ice of the close of 1858, and, as we most sincerely trust, with certain tidings of the lost navigators and their fate; but should any evil befall M'Clintock and his men, we feel assured that a heavy reckoning will be demanded by the country from those who have allowed him, single-handed, to go forth to do the work which ought to be the dearest privilege of the British Government, that sent forth Franklin and Crozier on their fatal errand.

It is not yet too late to send a second vessel through Behring's Straits to aid M'Clintock, in case any unforeseen accident should occur to prevent the release of the Fox from her icy cradle in the autumn of 1858; and we have sufficient faith in the generosity of our countrymen to believe that such an Expedition could be sent out without putting Lady Franklin to any additional expense. In fact, Captain M'Clure left England on the 24th of January, and reached the ice, by Behring's Strait, on the 1st of August, in 188 days. Deducting from this one-sixth for steam-power, we have 157 days; so that, if a screw steam-vessel were sent on the 1st of March next, she would reach the ice on the 4th of August, and have twenty days to run to the Mackenzie River, a distance of only 500 miles. The requisite organization for setting on foot such an expedition appears hitherto to have been wanting, and the time is now, perhaps, too short to effect the object thoroughly.

A commencement in this direction was made by some influential merchants in the town of Liverpool last July, as appears from the following Petition, presented to the House of Commons by one of the Members for the borough:—

"To The Honourable the Commons of the United Kingdom of Great Britain and Ireland, in Parliament assembled.

"*The Humble Petition of the undersigned Bankers, Merchants, and Ship-owners of Liverpool.*

"Sheweth:—That your Petitioners have been informed that an Arctic Expedition is now being fitted out at Aberdeen, at the expense of Lady Franklin, the object of which is to search by the Eastern, or Lancaster Sound route, the limited region of the Arctic Seas not previously explored (being 370 miles of coast), for the survivors (if any) of the crews of the Erebus and Terror, and the invaluable records belonging to those ships.

"That your Petitioners, while abstaining from an expression of opinion as to the prudence of that Expedition, believe that it is desirable to render it as safe as is consistent with circumstances over which man has no control, by despatching an Auxiliary vessel through the well-known and easily navigable route of Behring's Straits, to serve as a point of support to Lady Franklin's Expedition, in case of extremity arising from loss of ship or otherwise.

"That your Petitioners believe the Resolute, lately restored to this country by the American Government, to be a vessel well adapted for such a purpose; and that such a use of said vessel would be highly acceptable to, and hailed with satisfaction by, the American nation.

"That as the Fox schooner, under the command of Captain M'Clintock, R.N., will leave Aberdeen on the 26th inst., your Petitioners believe it to be important for her Commander to know, previous to his departure, whether he can depend upon the support of a vessel sent by the Western route or not.

"That some of your Petitioners are personal friends of Captain F. L. M'Clintock and his officers, and naturally feel much interested in the safety of his Expedition.

"For the reasons above mentioned, therefore, your Petitioners humbly pray your Honourable House to place the Resolute at the disposal of Lady Franklin, in the condition in which that vessel was restored to this country by the American nation, to be navigated at her expense, and that of friends, through Behring's Straits, as a support to the Fox Expedition.

"And your Petitioners will ever pray."

Owing to some misunderstanding between the advocates of rival plans among Lady Franklin's friends, nothing followed from a proposal which, we have no doubt, would have been most liberally aided by those who signed the Petition.

A similar attempt was made at the Meeting of the British Association in Dublin, which terminated in the following singular proposal of a method of aiding M'Clintock's Expedition:—It was determined to apply to Government to send out an Expedition to look for the Aurora Borealis, and to make magnetic observations, at the mouth of the Mackenzie River; it being expected, we presume, that the sailors should be instructed, while watching the auroral arches with one eye, to keep the other on the look-out for their brother tars of the eastern route. We hope the Government will good-naturedly pretend not to see the manœuvre, and become possessed of a desire to have the electrical condition of the atmosphere at the Mackenzie River accurately ascertained.

For our own part, we confess we think it would be a more manly and a more straightforward course, and also one more likely to succeed, to ask simply for what we want, and to instruct our representatives in the House of Commons to give the Government a hint that they would vote accordingly.

We turn with pleasure from the foregoing to the important services rendered to natural science by Sir Edward Belcher and M'Clintock. Sir Edward has added largely to our knowledge of organic life in high northern latitudes, both recent and fossil, by the collections he has brought home; the fossils of which are, we believe, deposited in the School of Mines, in Jermyn-street.

His appendix contains a contribution on the forms of Ice Crystals, written by himself, and illustrated by four well-executed plates representing the usual hexagonal forms of these bodies. This essay would be interesting, had he not taken care to discourage the reader at the outset by such truisms as the following, the interest of which cannot extend beyond the circle of his own immediate friends and admirers :—

"In several places in my narrative it may be noticed that I have exhibited a peculiar interest in the varied forms of snow crystals; possibly, to the minds of some, unable to appreciate the study of nature, deemed extravagant. Until that be proven, I am content to abide all the infliction which such pointless weapons can inflict. My intercourse with the world convinces me that no energy of character can be expected where no steady, intelligent pursuit of some department of science is not followed with confidence as well as enthusiasm."

In mercy to the writer we omit the remainder of the passage, which relates, *apropos des bottes*, to "Coal gas, that dreaded element of illumination." The description of the fish brought home from Wellington Sound was intrusted to Sir John Richardson, and, as might be expected, is of the highest interest. It is illustrated by eight plates, which are chiefly those of new or rare species.

The additions made by Sir Edward to the Molluscan Fauna are greater than might have been expected: out of forty-five species, twelve have not been hitherto described, but three had been previously known as doubtful. The account of these Mollusca has been drawn up by Mr. Lovell Reeve, and we have well-executed figures of the new species.

The Crustacea obtained were all dredged between Beechey Island and Northumberland Sound, generally in depths exceeding thirty fathoms, and have been described and catalogued by the first of British carcinologists, Professor Thomas Bell. One of these, a Cuma, is named after poor Goodsir; two plates, executed by Mr. Westwood, and containing many elaborate anatomical details, accompany Mr. Bell's descriptions. We may observe, that among the collections made by Captain M'Clintock, two species described here, one of them for the first time, and the other for the first time correctly, i. e., *Caprella spinifera*, and *Acanthosoma hystrix*, are very abundant.

Numerous fossils of the Silurian and Carboniferous epochs were brought home by the several exploring expeditions. Of the Silurian forms upwards of thirty were described by Mr. Salter in Dr. Sutherland's account of the voyage of the Lady Franklin and Sophia; of these, eleven are considered by him identical with known species from Europe and America.

Captain M'Clintock's collection, preserved in the Museum of the Royal Dublin Society, furnished six additional new forms; while Sir Edward Belcher has contributed none.

Dr. Sutherland's collection appears to have contained no Carboniferous forms; Sir Edward Belcher has contributed nine species, and M'Clintock six species.

Of the Carboniferous forms referrible to known European and American forms the following may be quoted:—*Productus Cora, P. semireticulatus, P. sulcatus, Spirifer Keilhavii, Cyathophyllum helianthoides,* and *Favosites Gothlandica.*

Many of the Silurian and Carboniferous forms occur together, apparently *in situ,* a fact respecting which the following comments are added to M'Clintock's Journal by Professor Haughton:—

"A question of very considerable geological interest is raised by the occurrence together of corals, in the same locality, of Silurian and Carboniferous forms.

"I entertain no doubt of their being *in situ,* and occurring in the same beds, for the following reasons:—

"1st. The Syringopores of Griffith's Island were found at an elevation of 400 feet above the sea, and, therefore, could not be brought by drifting ice.

"2nd. The specimens were apparently of the same texture and composition as the native rock, whenever the latter was visible from under the snow.

"3rd. I do not believe in the lapse of a long interval of time between the Silurian and Carboniferous deposits,—in fact, in a Devonian period.

"4th. The same blending of corals has been found in Ireland, the Bas Boulonnais, and in Devonshire, where Silurian and Carboniferous forms are of common occurrence in the same localities.

"5th. In the Carboniferous beds proper of Melville Island, and Bathurst Island, there were not found, so far as I am aware, any corals of the same character as those at Griffith's Island, Cornwallis Island, and Beechey Island, which could give a supply to be drifted to the latter localities in a Pleistocene sea. It is plain, from the height at which the corals were found, that, if they were brought to their present localities by ice, it must have been during the period known as Post-tertiary, as the present conditions of drift-ice in Barrow's Straits do not permit us to suppose them to have been placed where we now find them by existing causes."

The principal geological result of Sir Edward Belcher and Captain M'Clintock's collection is the undoubted establishment of the existence of a Liassic Basin in latitude 77° N., and probably extending from Exmouth Island to Prince Patrick's Island, a distance of 300 miles. At the first island some bones of a species of Ichthyosaurus were found in loose gravel by Sir Edward Belcher, and described (Plate XXXI.) by Professor Owen. The following account of their discovery is given by Sir Edward Belcher:—

"The position in which those remains were found is situated in latitude 77° 16′ N., and longitude 96° W., at 570 ft. above the level of the sea. The base of the island is a friable, disintegrating sandstone, which has been worn away on all sides, leaving the concentric elevation equal to one-third of its original diameter, rising abruptly from its base, so much so as to be accessible only on its western end.

"The summit is capped by a limestone formation of about one-fifth of the entire height, say 114 ft., resting on the sandstone, and leaving a dip at its western end of seven degrees."

Mr. Salter adds:—

"That several of the Carboniferous fossils (*Productus Cora*, *Spirifer Keilhavii*) were found on the top of Exmouth Island itself, the sandstone cliffs of which are capped by the limestone; and close upon this again lie the Ichthyosaurian bones."

The manner in which the Lias fossils occur in Prince Patrick's Island at Point Wilkie (Latitude, 76° 20′ N.; Longitude, 117° 20′ W.) is thus described by M'Clintock:—

"On landing, I found the beach low, composed of mud, with the footprints of animals frozen in it. A few hundred yards from the beach there are steep hills, about 150 feet in height, and upon the sides of these, in reddish-coloured limestone, casts of fossil shells abound. Inland of these, the ordinary pale carboniferous sandstone and cherty limestone reappeared. The fossils are all small, and of only a few varieties, some being Ammonites, but the greater part Bivalves. They differed from any I had met with before, and the rock was almost brick-red. Here, also, I picked up what appeared to be a portion of a fossil bone (*Ichthyosaurus?*), only part of it appearing out of the fragment of the rock.

"Point Wilkie appears to be an isolated patch of Liassic age, resting upon carboniferous sandstones and limestones, with bands of chert, of the same age as the limestones and sandstones of Melville Island. The eastern shore of Intrepid Inlet is composed of this formation; while the western, rising into hills and terraces, is of the underlying Carboniferous epoch. At the western side of Intrepid Inlet I found upon the ice a considerable quantity of white asbestos, but did not ascertain from whence it had been brought."

The fossils thus found by Captain M'Clintock are figured and described by Professor Haughton (Plate IX.), and consist of an Ammonite, Monotis, Pleurotomaria, Turbo, and Nucula.

Respecting these fossils Professor Haughton observes:—

"The discovery of such fossils *in situ*, in 76° North latitude, is calculated to throw considerable doubt upon the theories of climate which would account for all past changes of temperature by alterations in the relative position of land and water on the earth's surface. No attempt, that I am aware of, has ever been made to calculate in numbers the change of temperature possible in consequence of changes of position of land and water; and from some incomplete calculations I have myself made on the subject, I think it highly improbable that such causes could have ever produced a temperature in the sea at 76° North latitude, which would allow of the existence of Ammonites, especially Ammonites so like those that lived at the same time in the tropical warm seas of the south of England and France, at the close of the Liassic, and commencement of the lower Oolitic period."

Captain M'Clintock's ice-travels are accompanied by a geological map, embodying the principal results of the exploring expeditions. One of the most interesting features of this map is the line of outcrop of the Arctic coal-beds, extending E.N.E. from Banks' Land to Bathurst Island. The character of the coal itself is thus described, p. 30:—

"The coal found in the Arctic regions, excepting that brought from Disco Island, West Greenland, which is of tertiary origin, presents everywhere the same characters, which are somewhat remarkable. It is of a brownish colour and lignaceous texture, in fine layers of brown coal and jet-black glossy coal interstratified in delicate bands not thicker than paper. It has a woody ring under the hammer, recalling the peculiar clink of some of the valuable gas coals of Scotland. It burns with a dense smoke and brilliant flame, and would make an excellent gas coal; and, in fact, it resembles in many respects some varieties of the coal which has acquired such celebrity in the Scotch and Prussian law courts, under the title of the Torbane Hill mineral."

Among the fossils brought home by Captain M'Clure from Banks' Land, and deposited by him in the Museum of the Royal Dublin Society, is one considered by Mr. Haughton to be identical with *Terebratula aspera* (Schlotheim). In reference to this fossil the following remarks are made respecting the probable age of the Arctic coal-beds :—

"This interesting Brachiopod was found in limestone by Captain M'Clure, at the Princess Royal Islands, in the Prince of Wales' Strait, between Baring Island and Prince Albert Land. I have no hesitation in pronouncing it to be identical with Schlotheim's fossil, which is found in the greatest abundance at Gerolstein, in the Eifel. Banks' Land, or Baring Island, is composed of sandstone, similar to that at Byam Martin's Island, and at the Bay of Mercy. This sandstone contains beds of coal, apparently the continuation of the well-known coal-beds of Melville Island. It is a remarkable fact, that these carboniferous sandstones *underlie* beds of undoubtedly Carboniferous Limestone type ; and at Byam Martin's Island, where fossils are found in this sandstone, they are allied to *Atrypa fallax* and other forms characteristic of the lower sandstones of the Carboniferous epoch. It is, therefore, highly probable that the coal-beds of Melville Island are very low down in the series, and do not correspond in geological position with the coal-beds of South Wales, which rest on the summit of the carboniferous beds. It is interesting to find at Princess Royal Island, where, from the general strike of the beds, we should expect to find the Silurian limestone underlying the coal-bearing sandstones, that this limestone does occur, and contains a fossil, *T. aspera*, eminently characteristic of the Eifelian beds of Germany, which form, in that country, the upper Silurian strata."

We cannot part company with Sir Edward Belcher without expressing our regret that he has felt it necessary to make himself so prominent a figure in the foreground of the picture of Arctic voyaging that he has sketched; and we excuse him by the supposition that many of his pages were only designed to meet the eye of partial friends, and have been printed by mistake. What interest, for example, can he have expected the general reading public to take in the following ?—

"I cannot play the humorous or the buffoon, but truth, simple truth alone, in such pleasant terms as I can reduce it to, will prevail. I have nothing to gain and nothing to fear : my own family motto must guide me throughout. Those who despise 'Loya au mort' and loyal to facts must not depend too much for amusement in this narrative.

"Such, then, being my feelings, I proceed, in charity with all men, not perfect myself, and willing to overlook all faults in others, provided they do not, when I tell them of it, still continue to tread upon my corns."

In the foregoing Sir Edward kindly hints to his readers that his brother officers, who have written Arctic experiences, have played the buffoon and sacrificed truth ; we are also made aware of the motto of the great Belcher family, and informed that the writer possesses callosities, vulgarly called corns, but whether in his mind or on his body does not appear.

Among the many speculations hazarded respecting Sir John Franklin and his companions, a favourite, some years ago, was one which supposed them to be capable of existing for an indefinite period on the game, bears, seals, walruses, &c., of the Parry Islands and adjoining seas. This is now well known to be an impossibility in the greater part of these regions, and especially so in the direction of the Magnetic Pole, which is nearly coincident (as it ought to be), with the American Pole of maximum cold. The following facts respecting North Somerset, as compared

with the western Parry Islands, are conclusive on this interesting question:—

"An idea may be formed of the sterile nature of this locality [west coast of North Somerset],—the most desolate known in the Arctic Regions,—by the small quantity of game shot during our journey [forty days, 500 miles]: eight ptarmigan, seven or eight eider ducks, a few gulls, a diver, and two little phalaropes, comprise the entire list."

In M'Clintock's second sledge journey, along the southern shores of the Parry Islands (eighty days, 900 miles), the following is the list of game secured and sighted:—

"During our absence of eighty days the temperature varied from 52° above zero to 40° below; average temperature 15°, and range 92°, 4 musk oxen were shot, and 46 seen; 1 reindeer shot, and 34 seen; 2 bears shot, and 10 seen; 1 wolf seen, and wounded; 1 snowy owl seen, and shot; many hares, ptarmigan, brent geese, and ducks were seen, and a few of each shot. Much more might have been killed, but I never wantonly destroyed life; their presence often served to relieve that oppressive feeling which the desolation and unbroken stillness of the solitudes are wont to occasion."

In the third sledge journey (105 days, 1400 miles), in the western and north-western islands of the Parry group, the supplies appear to have been still more abundant:—

"As bearing upon the distribution of animal life, I subjoin a record of all that were shot or seen.

Locality.	Date.	Musk-oxen.		Rein-deer.		Hares shot.	Seals seen.	Gulls.	Brent Geese.		Ducks.		Ptarmi-gan.	
		Shot.	Seen.	Shot.	Seen.				Shot.	Seen.	Shot.	Seen.	Shot.	Seen.
Melville Island,	Between April 4 & May 13,	2	59	2	29	1	—	—	—	—	—	—	9	16
,,	July 1 and 19, . .	2	30	1	74	2	15	34	3	107	2	18	4	12
Prince Patrick's Island	May 14 & June 26,	3	5	5	8	1	2	12	2	20	—	5	9	37
Emerald Isle,	June 26 and 30,	—	—	—	13	—	1	7	—	—	—	—	—	—
Total amount of Animals met with		7	94	8	124	4	18	53	5	127	2	23	22	65

"No traces of bears were found. A few wolf-tracks were seen, but only on Melville Island. No traces of oxen, deer, foxes, or ptarmigan beyond the 77th parallel, except in one instance, when a decayed bone of a deer and traces of a fox were found. Up to 77° N., fox-tracks were frequently seen, although we never saw the animal. Lemmings were tolerably numerous wherever there was vegetation. Three kinds of gulls were seen. The ivory gulls (*Larus eburneus*) were the earliest to arrive, and were found furthest north; they began to lay eggs before the thaw commenced; eight only were seen, and all of them on Prince Patrick's Land. Seventeen glaucous, and twenty-eight skua gulls (*Lestris parasiticus*), the latter chiefly on Melville Island. Of the ducks, three were long-tailed (*Anas glacialis*), and the other twenty-two were king-ducks (*Anas spectabilis*). Several snow-buntings, sparingly, but universally distributed; four or five red phalaropes; two sea snipes; a raven; and a bird supposed to be a snowy owl, complete the list."

The meridian of the Magnetic and Cold Pole of America (95° W.) appears to be also the meridian of the minimum supply of animal food, not only in North Somerset, but farther north; as it appears from Sir Edward Belcher's account that the northern division, under his command, only secured twelve hares and twelve ptarmigan during their two winters' sojourn in Wellington and Queen's Channels, while the Resolute, at Dealy Island, obtained—

"*From* 3*rd September*, 1852, *to* 9*th September*, 1853.

Musk Oxen, . . .	114.	Average weight, . . .	166 lbs.
Reindeer, ...	95.	" . . .	60 "
Hares, ...	146.	" . . .	8 "
Bears, ...	6.		
Wolves, ...	3.		
Foxes, ...	51.		
Ptarmigan, . . .	711.	Average weight, . . .	1 lb.
Geese, ...	128.	" . . .	2½ "
Ducks, ...	229.	" . . .	2½ "
Plover, ...	16.		

On this subject Sir Edward Belcher, as we conceive, very justly observes:—

"But, notwithstanding our western parties passed over land where game abounded, their travelling duties and want of fuel to cook the meat procured, debarred them from the enjoyment of many fresh meals. To persons reduced to necessity there is every reason to believe that the means of sustaining a miserable existence might be found on the coasts of Cornwallis and Melville Islands; but it is fearful to contemplate the result, for most assuredly scurvy, in its most virulent form, would soon deprive them of the power to travel to a position where effectual aid might be available! But, granting that some more vigorous individuals might have been able to push forward, in the hope of sending back assistance, if encountered, we who have travelled and calculated the powers with sound men and good sledges, know full well that power to drag the carcases killed would not avail them beyond short distances, and that the first journey would probably carry them beyond the grounds where game resort! It has been imagined, because game has been found in particular spots, that it must prevail throughout those regions, and moreover, that on our particular ground it would yet (*sic*) be more abundant. The fallacy of such arguments is, I trust, now determined."

We cannot conclude without a reference to a speculation respecting the Erebus and Terror, published by Mr. Findlay in the "Journal of the Geographical Society," 1856. He considers the statement of the Esquimaux at Pond's Bay worthy of credence, and thinks the missing ships lay in the old pack ice at the southern bottom of Melville or Parry Sound from the summer of 1846 to that of 1850, at which period a party with a boat perished at Montreal Island, in the Back river. Mr. Findlay imagines the Erebus and Terror to have passed unobserved down Barrow Strait *after* Sir James Ross's departure and *before* the arrival of the Austin squadron, and identifies them with the two ships seen April 20, 1851, entangled in the ice, off the Newfoundland banks. At the same time Mr. Findlay admits that it is possible that Melville Sound may contain some hitherto unknown land, which was the scene of the wintering from 1846 to 1850. If this be so, in all probability

it will be thoroughly examined and explained by M'Clintock's sledge parties during the course of next summer. The extent of unexplored ground in the bottom of Melville Sound, between Osborn's and Wynniatt's farthests is, at most, 120 miles; and forms one of the chief points to which M'Clintock intends to direct his energies. This, and the unknown, though very limited region, westward of Boothia, and N. W. of King William's Land, will, we trust, be completely worked up, so as not to leave a single cape or bay in which the Erebus and Terror may lie, unexplored or unsought by the countrymen of those who perished in the very act of discovering the long-sought North-west Passage. It is melancholy to reflect that at the very time that Ross and M'Clintock were exploring the western shores of North Somerset, Franklin's parties were living and probably within easy reach; but the terribly barren character of every region of the meridian of the Magnetic Pole rendered it impossible to accomplish more than 500 miles out and home; while in the Parry Islands the same officer easily accomplished 1400. M'Clintock's account of this memorable spring journey in North Somerset, which was first published in the "Journal of the Royal Dublin Society," will always form a chapter, in this long and weary search, of sad and painful interest—the searchers and the sought probably within a few miles of each other, unconscious of each others' existence, and unable to communicate.

"Following the shores of North Somerset to its western extremity, 'Cape Bunny' (which we discovered to be an island), we found that a broad strait, leading southwards, intervened between us and Cape Walker. Hence, Sir James wisely determined to depart from his original intention of travelling to the westward, for the purpose of exploring this newly-found strait. Following the western shores of North Somerset, we endeavoured to traverse the whole of the unknown space intervening between it and the Magnetic Pole, in lat. 70° N., long. 97° W. Our failure was doubly unfortunate, 1st, because we were marching in the right direction, as the discoveries of Dr. Rae in 1854 have proved; and 2ndly, because a *magnetic* attraction in that quarter was most uncharitably attributed to our leader, who, it will be remembered, discovered the Magnetic Pole some eighteen years before.

"It is not to be wondered at that the succeeding expeditions were shy of attempting anything in that unpopular direction; hence, it remains to this hour the only unexplored area of the easily accessible portion of the Arctic Regions. It may not be out of place, perhaps, to remark that it was within sight of the Magnetic Pole that some forty or fifty of Franklin's crews were seen by the Esquimaux in the spring of 1850, dragging a boat to the southward, and the remains of which boat have since been found within the estuary of the great Fish River."

In our next Number we propose to give some account of the western searching parties, under Collinson and M'Clure, and of the physical causes, including the tidal currents, which appear to influence the detention of large masses of floe ice, only broken up at intervals of years, the presence or absence of which has exerted so striking an influence upon the success and safety of all the Arctic Expeditions. We again desire, in closing our present account of the search for Sir John Franklin, to express our conviction that the British Government has neglected a plain and obvious duty, in allowing a private expedition, fitted out by

Lady Franklin and her friends, to usurp the place which ought properly to be filled at the cost of the nation; and to state that, in our opinion, a day of reckoning must arrive, when the country at large will demand of its Government a statement of the reasons which have induced them to abandon the Arctic search, at the very moment when it appeared most certain of success.

ZOOLOGY: BEING A SYSTEMATIC ACCOUNT OF THE GENERAL STRUCTURE, HABITS, INSTINCTS, AND USES OF THE PRINCIPAL FAMILIES OF THE ANIMAL KINGDOM, AS WELL AS OF THE CHIEF FORMS OF FOSSIL REMAINS. By W. B. Carpenter, M. D., F. R. S., &c. A New Edition, thoroughly revised by W. S. Dallas, F. L. S. London: Henry G. Bohn, York-street, Covent Garden. 1857. Two Vols. Vol. I.

To Dr. Carpenter must, we think, in fairness be assigned the honour of having presented the student with a clearer and more comprehensive statement of the leading principles of zoological science than is to be found in the writings of any other living British naturalist. The care and industry with which he has collected, from a variety of sources, the numerous facts and opinions which have been incorporated in his works; the discrimination which he has shown in drawing his own conclusions, and performing the work of condensation—a task the difficulty of which can be appreciated only by those who have attempted it—are well calculated to save the student much subsequent (and, perhaps, fruitless) labour;—while the extensive acquaintance with the truths of science which is manifested in almost every page, together with the pleasing and perspicuous style in which all his information is conveyed, combine to render him at once both a competent and agreeable instructor.

The truth of these remarks must be evident to those who are familiar with the physiological writings of Dr. Carpenter, and we would refer our readers to the last edition of his "Principles of Comparative Physiology" as an instance of a work affording an almost exact representation of the state of physiological knowledge at the time of his publication.

Not so well known as the preceding, the "Zoology" of Dr. Carpenter has, nevertheless, been recognised among a numerous class of students as one of the most useful and complete of the various manuals on the subject of which it treats. Published, however, some twelve years since, it may readily be supposed that it had fallen considerably below the present state of science, and stood much in need of revision. The numerous avocations of Dr. Carpenter prevented him from executing a task which he was obviously the fittest person to perform; and accordingly, with his consent, the preparation of a new edition was intrusted by the publishers to Mr. Dallas. Mr. Dallas is already known to the public as the author of a work of a somewhat similar kind, which we noticed in a preceding Number (*vide* "Natural History Review," July, 1856).

In the preface we are informed by the editor that he "has endeavoured to preserve as much as possible of the original work, and also to maintain and follow out the author's mode of treatment in those parts which required alteration. Changes have been introduced only when they appeared to be imperatively called for; and in some instances, where a difference of opinion still exists in the minds of zoologists, the original statements of the author have been retained, even when opposed to the Editor's own views." Various changes will consequently be found scattered throughout the present volume. Thus the Dodo is transferred from the Cursores to the Columbæ, in accordance with the opinions of Strickland and Melville on this remarkable bird. The separation of the Batrachia from the Reptiles, and the division of the latter into four orders, is likewise an improvement. The classification of other groups, e. g. the Carnivora, is different from that adopted in the first edition; the Hyena, Badger, and Cercoleptus, being each made the type of separate families. Other minor changes have been introduced.

In a few instances the space devoted to the description of some of the more remarkable animals is, perhaps, too restricted. Thus the Proteus is dismissed in less than two lines. Again, the statement that the Hyperoodon is a rare visitant to our coasts is hardly reconcileable with the numerous accounts given of its appearance during the past few years. We do not, however, attach too much importance to these and other trifling inaccuracies, which seldom occur, and detract but little from the general merits of the work.

We had expected that some allusion would have been made to Professor Owen's recent classification of the Mammalia, a brief explanation of which would have added considerably to the merits of Dr. Carpenter's book. In this respect we have been much disappointed. The subject is in itself so interesting that we propose laying a short account of it before our readers.

It is well known that among the extensive range of subjects which has occupied the attention of our most eminent comparative anatomist, the classification of the Mammalia has long held a prominent place. The numerous opportunities afforded him of ascertaining by dissection the anatomical characters of many of the rarer and more remarkable mammals which have died at the Gardens of the Zoological Society, have enabled him to accumulate a mass of evidence of considerable importance in the decision of doubtful questions, and for the confirmation of opinions previously untenable for want of such testimony.

The external characters by which the Mammalia are distinguished from the other Vertebrata are sufficiently obvious, and need not detain us here. Not quite so remarkable, though equally characteristic, are those derived from an examination of the viscera and the organs of digestion, circulation, respiration, &c. Thus Professor Owen has shown that "the sacro-median artery, which in some long-tailed mammals assumes the character of the continued trunk of the aorta, never distributes arteries to the kidneys or the legs, as in birds," &c., &c.

The osseous system presents, likewise, its own peculiarities, such as

the appearance and number of the different vertebræ, &c., &c. Too much importance would seem to be attributed by many to purely histological characters. Professor Owen thus concludes his remarks on this portion of the subject:—

"There are few characters of the osseous system common, and at the same time peculiar, to the class Mammalia. The following may be cited:—

"1. Each half or ramus of the mandible consists of one bony piece developed from a single centre: the condyle is convex or flat, never concave. This has proved a valuable character in the determination of fossils.

"2. The second or distal bone, called 'squamosal,' in the bar continued backwards from the maxillary arch, is not only expanded, but is applied to the side wall of the cranium, and develops the articular surface for the mandible, which surface is either concave or flat. (The Wombat is, perhaps, the sole exception to this rule.)

"3. The presphenoid is developed from a centre distinct from that of the basisphenoid.

"In no other class of vertebrate animals are these osteological characters present."

The dental apparatus in the Mammalia is next noticed by Professor Owen, who in the short limits of five pages furnishes us with a concise though admirable summary of the different characters which it presents; characters which (as Professor Owen himself observes) "have not been clearly or accurately defined in any systematic or elementary work on Zoology, although an accurate formula and notation of the teeth are of more use and value in characterizing genera in this than in any other class of animals." The possession of the information contained in this portion of Professor Owen's article seems to us to be indispensable to every zoological student.

Having made these preliminary observations, Professor Owen then proceeds to the discussion of the main subject of his inquiry, namely, the true principle on which the primary divisions of the class Mammalia should be founded. Various attempts have from time to time been made to determine this important question. The first system which deserves notice is that of Aristotle, who founded his classification on the principal modifications presented by the locomotive system. The Mammalia or Zootoka were by him divided into three sections: 1st, Dipoda, or Bipeds; 2nd, Tetrapoda, or Quadrupeds; and 3rd, Apoda, or Impeds. The Tetrapoda are divided into those with claws and those with hoofs. The unguiculate quadrupeds are again subdivided according to the nature of their teeth; the ungulate quadrupeds according to the divisions of their hoofs, as, e. g., into Polyschidæ, or multungulates, Dischidæ, or bisulcates, and Aschidæ, or solidungulates. Professor Owen remarks that "this, in most respects admirable system, would have commanded greater attention, and been now recognised as more manifestly the basis of later systems, had its immortal author more technically expressed his appreciation of the law of the subordination of characters; but he applies to each of his groups, whatever their value, the same denomination, viz., genos or genus."

By Cuvier the Mammalia were subdivided according to the characters presented by the generative, locomotive, osseous, and dental systems, too much importance being in some instances attached to the latter.

The chief peculiarities in most modern systems have reference to the position which the Marsupial and Monotrematous mammals occupy. The parallelism between the subdivisions of the Marsupialia with the several orders of the placental mammals would seem to have more especially attracted the attention of the French naturalists. Geoffroy St. Hilaire went so far as to raise the former to the rank of a distinct class. The arrangement of the Mammalia by the late Prince C. Lucien Buonaparte, according to developmental and generative characters, and his subdivision of the Placentalia into the two groups of Educabilia and Ineducabilia, is regarded by Professor Owen as "the most important improvement in the classification of the Mammalia which has been proposed since the establishment of the natural character of the Implacental or Ovoviviparous division."

After mature deliberation, Professor Owen comes to the conclusion, that all the systems which have hitherto been proposed for the classification of the Mammalia are more or less liable to objection. He accordingly proceeds to give an explanation of his own views on the subject. These are based on the four leading modifications of cerebral structure which the Mammalia present.

"The brain is that part of the organization which, by its superior development, distinguishes the Mammalia from all the inferior classes of Vertebrata; and it is that organ, which I now propose to show to be the one that, by its modifications, marks the best and most material primary divisions of the class.

"In some mammals the cerebral hemispheres are but feebly and partially connected together by the 'fornix' and 'anterior commissure;' in the rest of the class a part called 'corpus callosum' is added, which completes the connecting or 'commissural apparatus.'

"With the absence of this great superadded commissure is associated a remarkable modification of the mode of development of the offspring, which involves many other modifications; amongst which are the presence of the bones called 'marsupial,' and the non-development of the deciduous body concerned in the nourishment of the progeny before birth, called 'placenta;' the young in all this 'implacental' division being brought forth prematurely, as compared with the rest of the class. This first and lowest primary group, or sub-class, of Mammalia may be termed, from its cerebral character, Lyencephala,—signifying the comparatively loose or disconnected state of the cerebral hemispheres. The size of these hemispheres is such that they leave exposed the olfactory ganglions, the cerebellum, and more or less of the optic lobes; their surface is generally smooth; the anfractuosities, when present, are few and simple.

"The next well-marked stage in the development of the brain is where the corpus callosum is present, but connects cerebral hemispheres as little advanced in bulk or outward character as in the preceding sub-class; the cerebrum leaving both the olfactory lobes and cerebellum exposed, and being commonly smooth, or with few and simple convolutions in a very small proportion, composed of the largest members of the group. The mammals so characterized constitute the sub-class Lissencephala.

"The third leading modification of the mammalian cerebrum is such an increase in its relative size, that it extends over more or less of the cerebellum; and generally more or less over the olfactory lobes, save in very few exceptions, cases of the smaller and inferior forms of *Quadrumana*, the superficies is folded into more or less numerous gyri or convolutions, whence the name Gyrencephala, which I propose for the third sub-class of Mammalia.

"In man the brain presents an ascensive step in development, higher and more strongly marked than that by which the preceding sub-class was distinguished from the one below it. Not only do the cerebral hemispheres overlap the olfactory lobes and cere-

bellum, but they extend in advance of the one, and further back than the other. Their posterior development is so marked that anatomists have assigned to that part the character of a third lobe; it is peculiar to the genus Homo, and equally peculiar is the 'posterior horn of the lateral ventricle,' and the 'hippocampus minor,' which characterize the hind lobe of each hemisphere. The superficial gray matter of the cerebrum, through the number and depth of the convolutions, attains its maximum of extent in man. Peculiar mental powers are associated with this higher form of brain, and their consequences wonderfully illustrate the value of the cerebral character; according to my estimate of which, I am led to regard the genus Homo as not merely a representative of a distinct order, but of a distinct sub-class of the Mammalia, for which I propose the name of Archencephala."

Having thus accurately defined these four sub-classes, in each of which certain anatomical characters accompany the several varieties of cerebral structure, Professor Owen enters upon the question of their subdivision into secondary groups or orders. In most modern works on zoology the Mammalia are divided into twelve orders, and the grade which they occupy in regard to cerebral development is generally stated to be somewhat as follows:—I. Bimana, II. Quadrumana. III. Cheiroptera. IV. Insectivora. V. Carnivora. VI. Cetacea. VII. Pachydermata. VIII. Ruminantia. IX. Edentata. X. Rodentia. XI. Marsupialia. XII. Monotremata. Such is the scale given in Dr. Carpenter's book. The opinions of Professor Owen are by no means in accordance with these; the Mammalia being by him divided into fifteen orders, and several of these are assigned a position in the scale of organization far different from that which they are usually said to occupy.

The sub-class Lyencephala includes two orders, Marsupialia and Monotremata. Thus, the true position which the Implacentalia bear to the other Mammalia is now for the first time clearly defined. Zoologists have long felt that the Marsupialia are of more importance than any other single order of the class (with the exception of Bimana), though at the same time they ought not to form a group parallel with the Placentalia. The utility of Professor Owen's views, in thus indicating the four subtypes which exist in the Mammalia, is here strikingly manifest.

The Lissencephala are divided into four orders, viz., Rodentia, Insectivora, Cheiroptera, and Bruta (Edentata). Two of the groups here included are, as we have seen, generally assigned a rank among quadrupeds, second only to that of the Quadrumana. Professor Owen, in opposition to the views of M. Gervais and Milne Edwards, traces the connexion between the Insectivora and certain of the Marsupials, and considers the Cheiroptera (with a few exceptions) as volant Insectivora. Certain other peculiarities in structure and habit indicate, in the opinion of Professor Owen, the low grade of the Lissencephala, such as the permanent irritability of muscular fibre among the sloths; the long, slender, beak-like edentulous jaws and gizzard of the Anteaters; the quills of the Porcupine and Hedgehog; the aptitude of the Cheiroptera, Insectivora, and certain Rodentia, to fall, like reptiles, into a state of true torpidity, associated with a corresponding faculty of the heart to circulate carbonized or black blood.

"These," he says, "and the like indications of co-affinity with the Lyencephala to the oviparous air-breathing Vertebrata, have mainly prevailed with me against an acquiescence in the elevation of different groups of the Lissencephala to a higher place in the mammalian series, and in their respective association, through some single character, with better brained orders, according to mammalogical systems which at different times have been proposed by zoologists of deserved reputation."

The above view of the true affinities of the Lissencephala is, perhaps, the most striking feature in Professor Owen's proposed classification. A glance at the following table, showing the correspondence between the Lyencephalous and Lissencephalous series will best indicate Professor Owen's meaning.

Lyencephala.	Lissencephala.
Rhizophaga,	Burrowing Rodentia.
Poëphaga,	Dipodidæ and Leporidæ.
Petaurus,	Pteromys.
Phalangistidæ,	Sciuridæ (new.)
Phascolarotos,	Bradypus.
Perameles and Myrmecobius,	Erinaceidæ.
Chœropus,	Macroscelis.
Didelphys and Phascogale,	Soricidæ.
Dasyuridæ,	Centetes, Gymnura.
Echidna,	Manis.
Ornithorhynchus,	Orycteropus.

Our space forbids us noticing at any length the third sub-class, Gyrencephala. This extensive group is divided into three sections, viz., Unguiculata, Ungulata, and Mutilata. The last of these includes two orders, Sirenia and Cetacea, the former of which contains those whale-like herbivorous mammals which in most systems form a portion of the Pachydermata. In the arrangement of the typical Ungulata the odd or even number of the toes is a character of some importance, and hence the names which Professor Owen has given to the two orders, Artiodactyla and Perissodactyla. The elephant is associated with Dinotherium, and other extinct genera, into a third order, Proboscidia; whilst a fourth, including none but fossil species, is named Toxodontia. The following Table shows the relations of the Ungulata:—

Ungulata,	Artiodactyla,	Omnivora. Ruminantia.
	Perissodactyla,	Solidungula. Multungula.
	Proboscidia,	Elephas. Dinotherium.
	Toxodontia,	Toxodon. Nesodon.

The Unguiculata are made up of two orders, Quadrumana and Carnivora. The latter are divided into three families, "Digitigrades," "Plantigrades," and "Pinnigrades." The highest place is assigned by Professor Owen to the first of these divisions, the internal structure of the bear showing its affinities to the seal tribe.

The Archencephala include one order, Bimana, and but one genus, Homo, worthy of this high position both by reason of zoological and physical distinctions.

Such is the simple and comprehensive system adopted by Professor Owen. The general result of his arrangement may be seen upon inspection of the accompanying Table.

CLASS—MAMMALIA.

SUB-CLASS.	ORDER.
Archencephala,	Bimana.
Gyrencephala,	Quadrumana. Carnivora. Artiodactyla. Perissodactyla. Proboscidia. Toxodontia. Sirenia. Cetacea.
Lissencephala,	Bruta. Cheiroptera. Insectivora. Rodentia.
Lyencephala,	Marsupialia. Monotremata.

OMPHALOS—AN ATTEMPT TO UNTIE THE GEOLOGICAL KNOT. By Philip Henry Gosse, F. R. S. London: Van Voorst. 1857.

WE have no hesitation in pronouncing this book to be the most important and best written that has yet appeared on the very interesting question with which it deals. We believe the logic of the book to be unanswerable, its postulates true, its laws fairly deduced, and the whole, considered as a play of metaphysical subtlety, absolutely complete; and yet we venture to predict that its conclusions will not be accepted as probable by one in ten thousand readers.

In reading "Omphalos," we have frequently been reminded of two works, very different from it and from each other: we mean Bishop Berkeley's "Dialogues," and Fontenelle's "Pluralité des Mondes." We pay Mr. Gosse the highest compliment in our power by comparing his work to those of such accomplished writers, but we are certain that he will not agree with us in thinking that the felt unreality of his book is one of the principal charms in common. The admirable manner in which Berkeley draws his reader on, step by step, until at length he compels him, to his astonishment, to deny the existence of an external world, finds a parellel in the process by which Mr. Gosse leads his readers to the conclusion that the fossils and other proofs of past duration, imbedded in the crust of the globe, are prochronic and not historic; that they

were placed there by the Creator, in accordance with a plan or law, of which there are numerous examples in the organic world; and are by no means to be considered as having ever really, i. e. actually, existed.

They existed, as Berkeley would say, as ideas in the Divine mind, entering into the perfect Plan on which the Almighty Architect has built our world, but never really lived and moved about upon the surface of our globe. We shall endeavour to present to our readers the simple logic, divested of all illustration, which forms the argument of Mr. Gosse, and then introduce to their notice some of the charming illustrations he has given of his principles.

Mr. Gosse assumes two postulates:—

1. The Creation of Matter;
2. The Persistence of Species;

and demonstrates two laws,—

1. All Organic nature [species] moves in a circle.
2. Creation is a violent irruption into the circle of nature.

I have added in a bracket the necessary limitation of Mr. Gosse's first law; it is only proved of each species of Organic nature, and is intended by him to be so limited.

A single example will serve to show the meaning of this law:—

"Here is in my garden a scarlet-runner. It is a slender twining stem, some three feet long, beset with leaves, with a growing bud at one end, and with the other inserted in the earth. What was it a month ago? A tiny shoot, protruding from between two thick fleshy leaves scarcely raised above the ground. A month before that, the thick fleshy leaves were two oval cotyledons, closely appressed face to face, with the minute plumule between them, the whole enclosed in an unbroken, tightly-fitting, spotted, leathery coat. It was a bean, a seed.

"Was this the commencement of its existence? Oh! no! Six months earlier still it was snugly lying, with several others like itself, in a green fleshy pod, to the interior of which it was organically attached. A month before that this same pod with its contents was the centre of a scarlet butterfly-like flower, the bottom of its pistil, within which, if you had split it open, you would have discerned the tiny beans, whose history we are tracing backwards, each imbedded in the soft green tissue, but no bigger than the eye of a cambric needle.

"But where was this flower? It was one of many that glowed on my garden wall all through last summer; each cluster springing as a bud from a slender twining stem, which was the exact counterpart of that with which we commenced this little life-history.

"And this earlier stem—what of it? It, too, had been a shoot, a pair of cotyledons with a plumule, a seed, an integral part of a carpel, which was a part of an earlier flower, that expanded from an earlier bud, that grew out of an earlier stem, that had been a still earlier seed, that had been —— and backward, *ad infinitum*, for ought that I can perceive.

"The course, then, of a scarlet-runner is a circle, without beginning or end:—that is, I mean, without a natural, a normal beginning or end. For at what point of its history can you put your finger, and say, 'Here is the commencement of this organism, before which there is a blank; here it began to exist?' There is no such point; no stage which does not look back to a previous stage, on which *this* stage is inevitably and absolutely dependent."—Page 113.

It follows necessarily from the Law thus illustrated, and from the Postulates assumed, that whenever it pleased the Almighty Creator to form an Organic species, He voluntarily subjected Himself to the condition, that the creature so formed should bear on it the marks of a pre-

vious possible existence, which, however, had no real being; or, to use a theological illustration—as an Arminian believes that when the Creator endued man with free will, He voluntarily surrendered part of His Divine prerogative of prescience,—so Mr. Gosse forces us to admit that when the Creator formed a species, He deliberately stamped it with a seal or mark, which, to one unacquainted with the fact of its creation, would induce, of necessity, the belief in its eternal pre-existence.

To use his own language:—

"The life-history of every organism commenced at some point or other of its circular course. It was created, called into being, in some definite stage. Possibly, various creatures differed in this respect; perhaps some began existence in one stage of development, some in another; but every separate organism had a distinct point at which it began to live. Before that point there was nothing; this particular organism had till then no existence; its history presents an absolute blank; *it was not.*

"But the whole organization of the creature thus newly called into existence looks back to the course of an endless circle in the past. Its whole structure displays a series of developments, which as distinctly witness to former conditions as do those which are presented in the cow, the butterfly, the fern, and scarlet-runner, of the present day. But what former conditions? The conditions thus witnessed unto, as being necessarily implied in the present organization, were non-existent; the history was a perfect blank until the moment of creation. The past conditions or stages of existence in question can indeed be as triumphantly inferred by legitimate deduction from the present as can those of our cow or butterfly; they rest on the very same evidences; they are identically the same in every respect, except in this one, that they were *unreal.* They exist only in their results; they are effects which never had causes. Perhaps it may help to clear my argument if I divide the past developments of organic life, which are necessarily, or at least legitimately, inferrible from present phenomena, into two categories, separated by the violent act of creation. Those unreal developments, whose apparent results are seen in the organism at the moment of its creation, I will call *prochronic*, because time was not an element in them; while those which have subsisted since creation, and which have had actual existence, I will distinguish as *diachronic*, as occurring during time."—Page 123.

We cannot see why Mr. Gosse should not also add a *metachronic* epoch to the history of each organic species, for the law of cycles in species looks forward as well as back, and carries us in imagination to the eternity *a parte post*, as surely as to that *a parte ante.* This is the flaw which invalidates all Bishop Butler's reasoning respecting the future life. His Law of continuance applies to brutes and plants as well as men, and proves their external past existence as certainly as their eternal future life.

We readily admit, with all its consequences, the statement of Mr. Gosse: that without a knowledge of the fact of creation (and of the fact of annihilation), a naturalist would necessarily infer that each species of organism had already existed, and would continue to exist for ever; or, to use the language of Playfair in reference to the globe itself, "the world shows no traces of a beginning, no prospect of an end." This is the natural and necessary inference of a mind unacquainted with the miraculous facts of the creation and annihilation of Organic species.

Having coerced his readers to agree with him thus far, Mr. Gosse informs them, next, that he only wants their assent to a single supposition as a bare possibility, in order to complete his solution of the Geological knot. This supposition may be stated as follows:—*Let it be granted*

as a bare possibility, that the world itself resembles an organic species in this respect, that its plan is that of a cycle; and it will follow that it must have been created, like each species, bearing the marks and signs of a *prochronic* life, which never was; and, we would add, in like manner, with marks and signs of a *metachronic* life, which never shall be.

Let us hear Mr. Gosse himself:—

"It is not necessary—at least it does not seem so to me—that all the members of this mighty commonwealth [all organic essences] should have an actual, a diachronic existence, any more than that, in the creation of a man, his fœtal, infantile, and adolescent stages should have an actual diachronic existence, though these are essential to his normal life-history. Nor would their diachronism be more certainly inferrible from the physical traces of them, in the one case than in the other. In the newly created man, the proofs of successive processes requiring time, in the skin, hair, nails, bones, &c., could in no respect be distinguished from the like proofs in a man of to-day; yet the developments to which they respectively testify are widely different from each other, so far as regards the element of time. Who will say that the suggestion, *that the strata of the surface of the earth, with their fossil Floras and Faunas, may possibly belong to a prochronic development of the mighty plan of the life-history of the world,*—who will dare to say that such a suggestion is a self-evident absurdity? If we had no example of such a procedure, we might be justified in dealing cavalierly with the hypothesis; but it has been shown that, without a solitary exception, the whole of the vast vegetable and animal kingdoms were created,—mark! I do not say *may* have been, but MUST have been created—on this principle of a prochronic development, with distinctly traceable records. It was *the law of organic creation.*"—Page 346.

Mr. Gosse, as we conceive, has failed to adduce a single good example of the law of cycles, or prochronism, as applied to the world itself, or to show that it resembles in this essential point the organic species, which forms an important part of it. His illustration, drawn from astronomy, is a failure.

"Take any one of the planetary bodies,—our moon. When its orbital motion commenced, it commenced at some point or other of the circle which it describes in its course around the earth. The pre-existence, or at least the coexistence, of the earth, and also that of the sun, are necessary to its motion."—Page 359.

This view of the planetary motions is altogether erroneous, as the moon's place in her orbit and velocity at any moment by no means presuppose a previous position and velocity; and she describes a different orbit each revolution. Mr. Gosse might have found in the motions of the moon and planets a much more powerful argument in favour of the extension of his law of organic species to the universe at large. We find that the planets revolve round the sun, the satellites round the planets, and the sun, planets, and satellites, on their axes in the same direction; that the planets and satellites revolve in nearly circular orbits, very slightly inclined to each other; that their polar diameters are uniformly shorter than their equatorial; and, in general, that the whole solar system carries in its structure the marks of having being formed, by way of natural law, from a previously existing gaseous substance or nebular mass. All these phenomena point backwards to a period antecedent to all geological phenomena, and prove clearly that if the solar system were created at any period between the present and

the earliest Cambrian epoch of geologists, that it must have been created with marks and signs pointing backwards, *prochronically*, to an anterior state which never actually existed, and so have conformed to the universal law of organic species.

We must remember, however, that Mr. Gosse is by no means called upon to prove the *probability* of the world following a cyclical law, similar to that of organic species. It is sufficient for his logical consistency to establish examples of that law in the creation of organic species (which he has undoubtedly done), and to assert confidently the *possibility* of a similar law prevailing in the structure of the universe, considered as a whole.

But the important question remains to be asked, whether, after all this display of logical subtlety, the world at large will believe one word of Mr. Gosse's theory. We are confident, and so we think is Mr. Gosse, that they will not. The religious geologist will believe as firmly that his fossils lived once actually and really, as he believes that the same God made both them and him. From Berkeley's day to the present hour, his theory of the non-existence of an external world has not gained a single convert; and we believe that Mr. Gosse's theory of *Prochronism*, as well as our own of *Metachronism*, will prove equally barren and unfruitful. They are idle speculations, fit only to please a philosopher in his hours of relaxation, but hardly worthy of the serious attention of any earnest man, whether scientific or not.

Mr. Gosse has introduced his speculation to the world under the guise of a legal investigation, involving the credibility of witnesses and the nature of their testimony, and he properly observes that the whole of geological evidence is of the kind called circumstantial:—

> "In the first place, there is nothing here but *circumstantial* evidence; there is no *direct* testimony to the facts sought to be established. Let it not seem unfair to make this distinction; it is one of great importance. No one has deposed to actual observation of the processes enumerated; no one has appeared in court who declares he actually saw the living *Pterodactyle* flying about, or heard the winds sighing in the tops of the *Lepidodendra*. You will say, 'It is the same thing; we have seen the skeleton of the one, and the crushed trunk of the other, and, therefore, we are as sure of their past existence as if we had been there at the time.' No, it is not the same thing, it is not *quite* the same thing; NOT QUITE. Strong as is the evidence, it is not *quite* so strong as if you had actually seen the living things, and had been conscious of the passing of time while you saw them live. It is only by a process of reasoning that you infer they lived at all."—Page 103.

We accept this forensic illustration, and would, in conclusion, ask Mr. Gosse's attention to the following view of the case he has made out for the Mosaic record of the creation.

A supposed criminal is formally accused before twelve of his countrymen, and in the opinion of eleven proved clearly guilty, on circumstantial evidence; but the twelfth juryman, or the prisoner's counsel, suggests *a possible*, although highly improbable, mode of viewing the circumstantial evidence, which is consistent with the hypothesis of the prisoner's innocence. The solitary juryman holds out against his obstinate brethren, and, being of a logical turn of mind, refuses to join in their

common-sense view of the evidence, because there is a bare *possibility* of the prisoner's innocence. In such a case as this, the sheepstealer or murderer goes forth to the world, with a brand of "not proven" stamped upon his character; he has been acquitted by a lawyer's trick, and is condemned by the good sense of the community. Who will employ him? Who can trust him? It would be better for him to be twice hanged, than endure the torture he is subject to in the world, whenever his previous history becomes the subject of discussion.

Such, we believe, is the position to which the theory of Omphalos would reduce the Mosaic account of the creation; a position, we are sure, which would be deplored as much by Mr. Gosse as by ourselves.

We do not think that the cause of religion is served by these attempts to remove difficulties by metaphysical subtleties.

> "Non tali auxilio, nec defensoribus istis
> Tempus eget."

The most wonderful mystery of all, the salvation of man by the atoning sacrifice of the Son of God, has more than once been endangered by the rash attempts of injudicious friends to explain what God had left obscure. For ourselves, we believe that a mode of reconciling all difficulties connected with the relation of the Bible to Science, *does exist*, and may be readily found, which would not detract one tittle from the authority of the former, nor require of us to abandon the use of our reason in the investigation of the latter.

A Monograph of the Fresh-Water Polyzoa, including all the known Species, both British and Foreign. By George James Allman, M. D., F. R. S., &c., Regius Professor of Natural History in the University of Edinburgh. London: Printed for the Ray Society. 1857.

Dr. Allman's Monograph on the Fresh-Water Polyzoa had long been announced among the forthcoming publications of the Ray Society. Such a work was much needed, and none seemed better fitted to undertake its preparation than a naturalist who had long made that group the object of his special study, and whose papers, published from time to time in scientific journals, constituted an important portion of the knowledge which we already possessed on the subject. The work has, however, at length been published; and those naturalists who have seen it will agree with us when we state that it has been executed in a manner in every respect worthy of its author. To those who have not, a slight notice of its contents may be desirable, in the hope that, perchance, they may be induced to take up a subject abounding in interesting details, and to which a valuable and trustworthy guide is now for the first time offered.

Dr. Allman's treatise may be said to consist essentially of two parts,

the first of which gives us an account of the anatomy and physiology of the Polyzoa as a class; while the second embraces the history and bibliography of the subject, and describes the specific characters of the fresh-water forms. The geographical distribution and habits of the Polyzoa are also considered.

In the brief space at our disposal, any attempt to convey an outline of Dr. Allman's views on the anatomy of the Polyzoa would be evidently impossible. We might, however, be permitted to remark that the thanks of naturalists, to which he is entitled for the introduction of a precise nomenclature into our descriptions of the Hydraform Zoophytes (*vide* Dr. Allman on "Cordylophora lacustris," Philosophical Transactions, 1853), are no less due to him for performing the same task in the case of the Polyzoa. The nomenclature referred to, and the reasons which induced him to adopt it, are best explained in his own words:—

"The old notion, which, by mistaking the zoological rank of the Polyzoa, erroneously referred them to the class of the Polypes, caused the same terms to be applied to them which were also used to designate the various parts of the true Polypes. The recognition, however, of a type of structure in the Polyzoa totally distinct from that of the Polypes proper, necessitates a change in the terminology employed in their description. On these grounds I have ventured to substitute some new terms for those previously used, while our increased knowledge of Polyzoal structure necessitates the use of certain additional terms, of which we have no representations in the descriptive terminology of previous authors. For the term Polypes, therefore, originally applied not only to the Polypoid Radiata, to which its use ought to be confined, but also to the retractile portion of the Polyzoa, I have substituted in the following memoir that of *Polypide.* To the common dermal system as a colony, which, as well as the solid basis of the true Polypes, was formerly known under the names of Polypary and Polypidome, I have applied the terme *Cœnœcium.* The cœnœcium is composed almost universally of two perfectly distinct tunics; to the external I have given the name of *Ectocyst*, and to the internal that of *Endocyst.* The sort of disk or stage which surrounds the mouth, and bears the tentacula, I have called *Lophophore.* The *Epistome* is a peculiar valve-like organ, which arches over the mouth in most of the fresh-water genera. The *Perigastric space* is the space included between the walls of the endocyst and the alimentary canal."

The several parts here indicated, the modifications which they undergo, and the functions they perform, are then minutely described, as is also the complicated muscular system which the Polyzoa possess. The nervous system in these animals consists of a single ganglion, from which several filaments are given off. In all the species which Dr. Allman has examined, with one exception (Paludicella), such a system has been found to exist.

The Molluscan type of structure manifested by the Polyzoa, and the remarkable homologies which they present to the Tunicata, are explained at some length, and the author compares his own views with those of Mr. Huxley on the same subject. The results of the recent investigations of Krohn and Leukart into the development of the Polyzoa are considered in reference to this important relation. The connexion of the Brachiopoda with the other Molluscoida, as maintained by Mr. Huxley, is viewed in a different light by Dr. Allman. We would willingly stay to discuss these interesting questions, did our limits permit of so doing.

Three modes of development occur among the Polyzoa, viz., first, true reproduction by ova; secondly, by gemmæ; and thirdly, by bodies of a peculiar nature termed *statoblasts*, which, however, may be regarded as "gemmæ in which the developmental activity remains for a time latent." The structure and mode of growth of these statoblasts are often exceedingly curious. In some Polyzoa the multiplication of the compound structure takes place by a process of self-division. This mode of increase may be referred, however, to the second of the above methods, for, as Dr. Allman truly observes, there is no real difference between gemmation and fission.

The classification of the Polyzoa proposed by Dr. Allman will be best understood by an inspection of the following Table:—

CLASS—POLYZOA.

ORDERS.		SUB-ORDERS.
Lophophore bilateral; mouth with an epistome. Phylactolœmata.	Arms of lophophore free or obsolete.	Lophophœa (fresh water).
	Arms of lophophore united at the extremities.	Pedicellinea (marine).
Lophophore orbicular, or nearly so; no epistome. Gymnolœmata.	Polypide only partially retractile.	Urnatellea (fresh water).
	Polypide completely retractile; evagination of tentacular sheath imperfect.	Paludicellea (fresh water).
	Polypide completely retractile; evagination perfect; orifice of cell destitute of movable appendage.	Cyclostomata (marine).
	Polypide completely retractile; evagination perfect; a circle of setæ attached to the invertible portion, and acting as an operculum in the retracted state.	Ctenostomata (marine).
	Polypide completely retractile; evagination perfect; orifice of the cell with a movable lip.	Cheilostomata (marine).

The fresh-water species are referred to eight genera. Of these, six are included under the sub-order Lophophœa, which is divided into two families: Cristatellidæ, which contains but one genus, Cristatella; and Plumatellidæ, which contains five, viz., Pectinatella, Lophopus, Alcyonella, Plumatella, and Fredericella. The sub-orders, Urnatellea and Paludicellea, include each but one family and one genus, named respectively Urnatella and Paludicella.

All the known fresh-water species, both British and foreign, are described in Dr. Allman's monograph. Of the twenty-one species mentioned, seventeen are found in the British Isles. Many of these are now de-

scribed for the first time. More than half of the species belong to one genus, Plumatella, which includes twelve forms, of which nine are British. In each of the other genera, with the exception of Alcyonella, which contains three, there is but a single species. Of these, perhaps, the most remarkable is Cristatella, which presents us with the strange anomaly of a locomotive Polyzoon.

The remarks on the history of the Polyzoon are full of interest, and contain an account of the successive steps which have been made towards a more complete knowledge of the class, since the appearance of Trembley's description of the "Polype à Panache," in 1744, to our own time. We are glad to notice the honourable mention which is made of the valuable researches of Mr. J. V. Thompson, and the just acknowledgment of his title to the priority of the term Polyzoa.

We have as yet said nothing of the coloured lithographs with which Dr. Allman's work is illustrated, which have been executed by Mr. Tuffen West, from original drawings made by the author. Of these plates it is impossible to speak too highly. Many of the species are now represented for the first time, and all are depicted with an accuracy, elegancy, and delicacy of colouring, which leave nothing to be desired.

Finally, we would conclude by expressing the obligations we are under to Dr. Allman for the scientific manner in which his task has been fulfilled, and to the Ray Society for being the means of introducing us to a work which may well take rank with the "Nudibranchiate Mollusca" of Alder and Hancock; the "Naked-eyed Medusæ" of Forbes; or the "Cirripediæ" of Darwin.

A Catalogue of the Zoophytes of Northumberland and Durham. By Joshua Alder. 8vo, pp. 72. Eight Plates. From the Transactions of the Tyneside Naturalists' Field Club. 1857.

We are pleased with this Catalogue. Much care has evidently been spent in its preparation. The observations which it embodies are both numerous and valuable. The descriptions of rare, in some instances of new species, which it contains, would alone suffice to render it worthy of our notice, but it also forms a welcome contribution to the scanty knowledge which we possess of the distribution of this imperfectly studied class of animals. Both the Zoophytes and Polyzoa are described; of the former, seventy-eight species are recorded as inhabiting the Northumberland and Durham coasts; of these, sixty-five belong to the Hydroid division, three to the Asteroid, and ten to the Helianthoid orders. The great deficiency among the number of species of the two last-mentioned orders is worthy of remark. The *Anthea cereus* is a stranger to our north-eastern shores. On the other hand, many forms occur, especially in the Hydroid group, which are scarce in other localities; and some species, altogether new to science, are here recorded.

Among the Tubulariadæ, two new species of Eudendrium, one of Tubularia, and a very interesting zoophyte, *Vorticlum humilis*, hitherto undescribed, are here for the first time mentioned. Additions are also made to the genera of Sertularia, Laomedea, and Campanularia; but more interesting than any of these is the name of a species belonging to the American genus, Grammaria (*Stimpson*). This genus is now first placed among the European Fauna.

Among the Helianthoida, *Anthea Tuediæ* appears characteristic of northern localities. One new species of Actina, *A. pellucida*, occurs. As before stated, this order would appear to be but scantily represented.

No less than eighty-six species of Polyzoa are given; six of these are fresh-water forms, and several others are additions to our lists. The genera thus enriched are Bugula, Membranipora, Alcyonidium, and Farrella. A minute Polyzoon discovered by Mr. Alder is made into a new genus, denominated Buskia, a well-merited compliment to the author of the valuable British Museum Catalogue of these animals.

A list of the leading species of Zoophytes and Polyzoa, arranged according to the zones of depth which they frequent, will be found useful as affording data for future investigations, and it is highly desirable that the distribution of both these classes of animals should be more effectually studied. Whole districts exist around the British coasts, of the exact nature of whose marine Fauna much has to be learned. The present Catalogue may be regarded as a sample of the most useful form which local lists may be made to assume, and thus serve as a guide to those who possess materials, but who are undecided as to the best mode of publishing them.

Eight Plates, representing the new forms described therein, accompany Mr. Alder's Catalogue, which we recommend to our readers as a useful and even necessary supplement to the second edition of Dr. Johnston's British Zoophytes.

The Insect Hunters. By Edward Newman, F. L. S. Fcap. 8vo, gilt edges, 1*s.* 6*d.* London: John Van Voorst.

Although we cannot agree with the classification that Miss Laura is instructed in, in the course of this little volume, yet we welcome it as a very pleasing addition to our list of children's books. We would advise them to refrain, however, from the advice given in a contemporary, of "devouring its pages,"—children that we thought would do this, we would not give the book to. The measure in which this insect poem is written is that of Longfellow's "Hiawatha,"—one eminently fitted for the not very euphonious names adopted. We know of no volume that abounds with so much information, in so small a compass, on the habits and economy of insects, and none that we have had so much pleasure in making a present of, to such of our young friends as cared about the subject.

Day & Son, Lithʳˢ to the Queen


125°
120°
90°
C.Mc Clint
Satellite Bay
Graham I.
Limit of
ELAGO
CHER
CHANNEL
PRINCE
PATRICK
ISLAND
Parker Bay
Intrepid Inlet
Nth Kent
Cape Canning
Lands End
CROZIER
CHANNEL
Walker Inlet
C.Manning
Dyer Bay
C.Mecham
Eglin-ton I.
KELL
STRAI
C.Nares
Purchas
Cape Russell
C.C
Warr
N
77°
76°
75°
74°
73°
C.Wrottesley
Ballast Beach
C.Maclure
B A
S T
C.Hurd
Bay of Mercy
Prince Alfred C.
L A N
Leopold I.
C.Y.
B A R I N G
O R
B A N K S
L A N D
PRINCE
REGENT
INLET
P.Bowen
Princess Royal Is
Deans Dundas Bay

1. M'Clure's Discovery of the North-West Passage. Edited by Captain Sherard Osborn, C. B., &c. Second Edition. London: Longman, Brown, Green, Longmans, and Roberts. 1857.

2. A Personal Narrative of the Discovery of the North-West Passage. By A. Armstrong, M. D., R. N., late Surgeon and Naturalist of H. M. S. "Investigator." London: Hurst and Blackett. 1857.

3. An Arctic Voyage to Baffin's Bay and Lancaster Sound, in search of Friends with Sir John Franklin. By Robert Anstruther Goodsir. London: Van Voorst. 1850.

(WITH A MAP.)

The great tidal wave enters the Polar Sea, from the Atlantic, by two distinct channels, separated from each other by the Continent of Greenland. The first branch of the Atlantic Tide, having swept past the British islands and coasts of Norway, flows into the Polar Sea, past the island of Spitzbergen, being assisted in its flow, and retarded in its ebb, by the remains of the Gulf Stream, which is probably still felt in its heating effects by the glaciers of Spitzbergen. Of the oscillations and movements of the Polar Sea itself, north of Europe and Asia, we know but little, excepting the fact, furnished to us by Von Wrangel, that its resultant effect on the north-east coast of Siberia is felt in a current setting east by south towards Behring's Strait: arrived at this point, it becomes complicated in its action by the influx of the Pacific Tide, whose movements are totally different in character. The combined Atlantic and Pacific Tides (the latter predominating) flow and ebb in an east and west direction along the coast of North America, with a preponderant set to the eastward, round Point Barrow, Cape Bathurst, through Dolphin and Union Strait, and Dease's Strait; and probably into Victoria Strait as far as the bottom of Peel Sound and Bellot Strait, leading into Prince Regent's Inlet. It is highly probable, although it has not been distinctly proved, that off shore, both in Asia and North America, the Atlantic Tide and Gulf Stream produce a resultant movement of the waters of the Polar Sea, which presses its loose pack ice, eastward and southward, against the western and north-western shores of the Parry Islands, forming the great pack ice observed by M'Clintock on the north-western shore of Prince Patrick's Island, and also the formidable double and triple floes to the west and north of Banks' Land, which so nearly proved fatal to the "Investigator" during her short and dangerous run from Nelson Head to the Bay of Mercy. To the westward of Banks' Land, at some distance off shore from the American Continent, is found the permanently ice-blocked sea, called by the western Esquimaux, in their simple language, the "Land of the White Bear." This gigantic ice-floe we believe to be formed by the continued eastern set of the deep tidal and oceanic currents of the Polar Sea east of Spitzbergen; and that it is prevented from permanently blocking up the coast line of the American Continent only by the influence of the rapid tides which enter the Polar Sea, from the Pacific, through Behring's Straits. These tides,

which are very peculiar in their character, have been investigated with much labour and pains by Captain Rochfort Maguire, of H. M. S. "Plover," who studied them at Point Barrow; and by Captain Collinson, of H. M. S. "Enterprise," who made the tides a special object of investigation both in Walker Bay, Prince Albert's Land, in 1851–52, and in Cambridge Bay, Victoria Land, in 1852–53. We have reason to believe that the tidal observations made under the direction of both these gentlemen are at present undergoing a careful discussion, and that the results, which are likely to prove of much interest, will in due time be brought under the notice of the Royal Society.

Let us return for a moment to the second branch of the Great Atlantic Tidal Wave, which we left flowing northwards into Baffin's Bay, to the west of Greenland. The flood tide of this wave, having filled Baffin's Bay, flows northward through Smith's Sound, and westward through Jones' Sound and Lancaster Sound, through which latter it causes high water in succession in Prince Regent's Inlet, Wellington Channel, Austin and Byam Martin Channel; and finally meets the Pacific and Polar Tides at the entrance of Banks' and Prince of Wales Straits. A glance at the accompanying map will explain more rapidly than words our view of the limit or head of the Baffin's Bay Atlantic Tide. It meets the Pacific Tide at Bellot's Straits, and the Pacific Polar Tide in Prince of Wales and Banks' Straits; and it meets the true Polar Tide in the centre of Byam Martin Strait, and in the open space (generally blocked with ice floes) between the Queen's and Wellington Channel; again, in Cardigan Strait and Belcher Channel, and far to the north of the Map in Smith's Sound, somewhat to the north of Dr. Kane's winter quarters. The arrows on the map represent the direction of the Tidal Streams during flood tide; and they should be reversed during ebb tide.

According to the foregoing view of the Polar Tides, the limit of the Atlantic Tide represents still water at all times of tides, the currents flowing to and ebbing from the "head line" of Tide in opposite direction, in the manner so well known in the Irish Sea and English Channel, and North Sea—forming permanent slack water near the Isle of Man, and from Dover to Beachy Head. In a sea impeded by broken ice floes, the effect of such a meeting of tidal streams, and consequent slack-water, will be to produce an almost permanent and immoveable thickened floe.

Let us inquire how far the facts are in accordance with the foregoing theory:—

1. *Prince of Wales Strait.*—On the 26th October, 1850, as is well known, Captain M'Clure discovered the North-West Passage, leading from this Strait into Melville Sound and Barrow's Strait, by means of a sledge party pushed on from his ship to Mount Observation (Lat. 73° 31′ 39″ N., Long. 114° 14′ W.); but all his efforts to force the "Investigator" through the few miles that separated her from Barrow's Strait proved unsuccessful.

"On the 16th September, she still made slow progress towards Barrow's Strait, and on the 17th September, 1850, reached their most advanced position in lat. 73° 10′ N.,

and Long. 117° 10′ W., about *thirty miles* from the waters of that series of straits which, under the names of Melville, Barrow, and Lancaster, communicate with Baffin's Bay. At this tantalising distance, the ship ceased to drift, and the ice appeared to have reached a point beyond which some unknown cause would not allow it to proceed. The heavy pack of Melville Strait lying across the head of the channel was supposed to be the reason of the ice of Prince of Wales Strait ceasing to move on to the north-east; and the impassable nature of the pack in the same direction, in the following year, confirmed this hypothesis."—*Osborn*, p. 114.

The set of the flood tide in the Prince of Wales Strait, almost up to its northern extremity, was from the *south*, and belonged, therefore, to what we have called the Polar Pacific Tide.

"The set of the currents or tides had long been an anxious question with Captain M'Clure: the tide-pole in thirty fathoms water was not a sure guide; but, so far as its help and twelve months' observation enabled him to form an idea, the flood-tide came from the south up the strait, the rise and fall being about *three feet at spring-tides*, and *little, if anything, at the neaps.*"—*Osborn*, p. 200.

In the August of the following year, 1851, the Investigator again failed to force her passage through the ice-blocked "head of the tide" which occupies the northern extremity of Prince of Wales Strait.

"The 'Investigator' was again beset in the ice, and with slight intermission continued so until the 15th of August, during which time she drifted about two miles *per diem* to the north-east with it, and eventually reached 73° 43′ 43″ N. latitude, and longitude 115° 32′ 30″ W., in which position she remained at the tantalising distance of *twenty-five miles from the waters of Barrow's Strait!*

"Further than that, no effort could advance the ship, and there were occasional sets of the ice to the south-west, with N. E. winds, which threatened to send them back from whence they came. The young ice at nights had already begun to form, the sun again set, and darkness had commenced, and Captain M'Clure knew that his days of navigation were every day diminishing. If he could push into the pack of Barrow's Strait, with a prospect of drifting with it to the eastward for Lancaster Sound, he was prepared to do so; but it would be folly merely to get entangled in it at the entrance of Prince of Wales Strait, and be swept back again to winter, in 1851–52, in the same place he had occupied last year. Impressed with this feeling, it was with no small anxiety, when about noon on the 16th of August, the fog having lifted, that he proceeded to take a careful survey of the ice ahead, before he decided upon launching into it, or adopting some other course by which to carry his ship through the North-West Passage in safety; and to perfect upon one line at any rate the search for his missing brother officers. He says:—'I observed the ice closely packed, extending across from one side of the Strait to the other;' it formed an unbroken line without a prospect of successful passage through it for a sailing ship; and then he immediately determined, with that decision which formed the secret of his wonderful success, to bear up, go round the south end of Banks' Land, and endeavour, by passing to the westward, to reach Melville Island from that direction."—*Osborn*, p. 202.

As if to demonstrate the impossibility of effecting a passage through the head of the tide, in a narrow polar strait, such as that of the Prince of Wales, a fortnight later the "Enterprise," under Collinson, also failed in her efforts to pass through the same channel into Barrow's Strait; and it is well worthy of remark that it was only the ten or twenty miles at each side of the head of the tide that presented any difficulty, as both ships found it easy to sail up and down the Strait as far north as the Princess Royal Islands. In that portion of the Strait the ice was kept

in constant motion north and south by the rapid flood and ebb of the Pacific Tide.

2. *Banks' Strait.*—On the 23rd September, 1851, the "Investigator," having made her fearful passage between the "Land of the White Bear" and Banks' Land, was forced to take shelter in the Bay of Mercy, about forty miles to the westward of the head of the tide in Banks' Strait.

As there is considerable difference of opinion as to the necessity of their entering the Bay of Mercy at all, instead of pushing to the eastward, and trusting to the tidal and other currents to force the ship in the ice-floe through Banks' Strait into Melville Sound, we shall give both M'Clure's and Armstrong's account of the transaction.

"The 23rd of September, 1851,—the last day of the gallant ship's achievements,—came in most promisingly. Water was seen ahead long before day-dawn, sail was set, and she battled on all day to the eastward, making a little southing, as the land trended that way. Hitherto Captain M'Clure had avoided pushing on after dark, since the nights had now become so long; but for many cogent reasons he was induced on this occasion to depart from this rule; and, as the result proved, it was unfortunate in one respect that he did so, for about half-past seven o'clock in the evening the ship ran ashore on a steep bank. The crew strained every nerve to get the vessel off; and after clearing the fore-hold and store-rooms, and laying out a stream-anchor and cable, she floated off during the night.

"On the next day they found themselves in a large bay, affording good winter quarters, and perceived that it was impossible to round its north-eastern horn, so as to enter the pack and drift with it through Barrow's Strait during the coming winter. Under these circumstances, and considering what they had gone through in reaching the secure spot into which they had steered during darkness, Captain M'Clure made up his mind to winter where he was; and, in token of his gratitude to a kind Providence, the bay was appropriately called the Bay of Mercy. It was no empty expression; for every heart in that ship was filled with emotion, and many prayed that in after years, should they be spared to reach their homes, the recollection of the bounty and goodness of Him who had upheld them through such anxieties and dangers might never be effaced from their memories."—*Osborn*, p. 221.

"The 23rd of September was a luckless day for the 'Investigator.' The men had continued uninterruptedly at work during the night, and at 1 A.M. the ship drifted a little, when another anchor was let go in fifteen fathoms. The gale continued from the westward veering at times to W.N.W., but moderated with the advance of daylight. This period of the morning, so ardently wished for, at length came, and fully revealed to us our position; from which it appeared that by keeping close to the land, we had been running into a deep bay; that the bank on the extremity of which we had grounded formed a sort of crescent or horn, at its north-western entrance extending about a quarter of a mile from the beach, and a good bulwark against the encroachment of ice on a ship placed in the water inside and beyond it. The coast line along which we ran trended to the south, and then, sweeping round to the N.E., formed this extensive bay, which was then quite clear of ice, some twelve or thirteen miles in depth, its north-eastern boundary running directly across our course: its entrance (Point Back) being exactly opposite to our position, and distant about seven miles. The land appeared of a hilly, lofty character, between which and our position the appearance of shoals were reported from the mast-head; but we did not verify the fact by closer inspection. Mr. Court was then dispatched to sound the bay inside, south-east of the shoal, to ascertain its eligibility for anchorage; the ship following the course of the boat until 9 A.M., when we furled sails, and anchored in four fathoms, about 600 yards from the shore, and about three miles inside the bank on which we had grounded. It was, therefore, determined that this position should constitute our winter quarters, despite any change that might take place to

favour a further advance, lest we should not succeed in procuring another so eligible as it was considered to be. At noon all work was completed, and our crew, after nearly thirty hours' continuous labour, were allowed to rest for the remainder of the day.

"We were thus doomed to spend a second winter in the ice, after all the anticipations we had formed of reaching Melville Island; and, I must say, it was a sad and bitter disappointment to us all. Entering this bay was the *fatal* error of our voyage. This opinion I formed at the time, personally expressed it, and recorded it in my Journal; therefore I could not be, in any degree, influenced by subsequent events; and, that the decision then arrived at, of entering this bay, was a hasty one, was fully established by its results.

"We had, previously to our entering this bay, made no attempt to reach Point Back, although an open sea was before us. The reported existence of shoals (which we did not examine), and the appearance of the ice, setting down on it from the northward, caused it to be considered not prudent to do so. Nor did we make any attempt to reach the pack edge, with a view of pushing through its loose ice, and endeavouring to get further to the north-east. Although the wind had become more northerly, and was bringing the ice down, it was nothing more than what is termed loose sailing ice in our immediate neighbourhood, through which a ship might for some distance have worked her way, as the sea is at this time of the year clearer of such impediments than at any other; more may, therefore, be accomplished in a few days than in as many months at any earlier period. By doing so we would have got fairly within the influence of the current setting to the eastward through Banks' Strait, and would have been further aided by the prevailing winds from the north-west. Although we might have been temporarily beset, we should still have been borne in the direction we wished to go, and, as the pack opened out, have got into one of its numerous lanes of water, that would have led us to Melville Island, then distant little more than fifty miles. Or, had we failed in doing this, we might have been drifted such a distance to the eastward as to render our getting through, on its breaking up in the following season, a matter of still greater certainty. Wintering in the pack all Arctic navigators had hitherto viewed with the utmost dread; and though I admit it to be perilous and dangerous, our experience of the previous winter was satisfactory evidence that it could be done with safety; and this was, I believe, the first time the experiment had been made. Great and imminent as were the dangers which then threatened us, as well as in the late terrible passage we had just made, we had then become so accustomed to danger, and to encounter fearlessly the worst aspect this element could assume, that we viewed, without apprehension, the risks and chances of another winter in the pack, had it been so decreed—so anxious were we to make the North-West Passage in the ship, and bring the 'Investigator' in safety to England. I am, therefore, firmly convinced, that had we not entered this bay, but boldly pushed into the pack, it would have led to a consummation of all our ardent hopes and wishes.

"There are few states of mind from which one cannot draw some degree of consolation, however great may be the disappointment or deep the regret; and we then drew largely on ours. It was, however, satisfactory to reflect that, although the ship had only been actually under weigh for five days during the season, we had prosecuted the search over a wide extent of coast line, and added largely to geographical science by establishing the insular character of Baring Island, besides discovering a *second* 'North-West Passage' between the Atlantic and Pacific Oceans, in a direct line through Banks' Strait, in a voyage that stands unparalleled as the most perilous ever made in the Polar Sea.

"We, therefore, entered this bay,* disappointed as we felt in doing so, with a firm reliance on Providence that we might be enabled to leave on the following season in a state of as great efficiency as we had then entered it."—*Armstrong*, p. 461.

We must leave to others more competent than ourselves to decide between these conflicting statements; but we feel bound to add that

* "The bay subsequently received the name of Mercy, in remembrance of the perils we had escaped; but some amongst us not inappropriately said, it ought to have been so called from the fact that it would have been a *mercy had we never entered it.*"

Captain M'Clure's own statement of the state of the ice *outside* the Bay of Mercy, in the following year, fully confirms the possibility of Dr. Armstrong's assertion, that the "Investigator" might have been forced farther east than that bay.

"Hope rose high when, about the 16th of August, open water was seen in the straits and the ice of the bay itself began to be loosened from the shore, though it was still confined by the ice outside. A day or two later, however, the bay opened at the outer end, and the imprisoned navigators saw, with delight, that a broad lane of water extended along the southern shore for ten miles to the eastward. Their hope of reaching it lay in a strong south wind blowing the ice of the bay and the ship out with it to seaward. As to sawing the whole distance between her and the water, it was impossible; before it could be done winter would be on them. There was a chance of such a wind and such a release, and the top-gallant yards were crossed, sails bent, and the tide pole taken in. Its registry during ten months gave as a result, that the tide rose two feet, and that the highest tide was four tides after the full and change of the moon. A beacon was erected in lat. 73° 6′ 48″ N., and long. 118° 15′ W., and in a cylinder attached to a pole was placed a record, telling what the Investigators had done, and whither they expected to go, 'in the hope,' says the leader of the expedition, 'that it may meet the eye of some future explorers of these sterile regions, and throw some light upon the fate of those who perhaps may never reach beyond these limits.'

"The expectation of escape was, however, but short-lived. After the 20th of August the temperature fell, slowly but continually; and when the bay, or that portion of it that had been open, again froze over, all felt that summer was past, and some unforeseen accident could alone save them from wintering again in Mercy Bay. Their summer, poor fellows, had been a most cheerless one; the sun, from the cloudy and misty state of the atmosphere, not having been, with few exceptions, seen since May."—*Osborn*, p. 256.

It is remarkable that it was on the 16th of August, 1820, that Parry made his farthest distance west towards Banks' Strait, on the south shore of Melville Island, near Cape Hay. In this remarkable voyage Parry must have been within five miles of the head of the tide, on the side opposite to M'Clure; and as the water was open in 1852 for ten miles to the east of the Bay of Mercy, it appears certain that if the Investigator had been in Banks' Strait instead of the Bay of Mercy, that she would have lessened her distance from the head of the tide to probably twenty miles.

But the question remains, Could she have ever passed that line? We think not; and that her fate would have been, to be crushed to atoms in the pack ice of Banks' Strait, formed by the junction of the Atlantic and Polar tidal streams. We must not forget that both M'Clure and Collinson failed to pass this line in Prince of Wales Strait, although they both approached it much nearer than M'Clure could approach the same line in Banks' Strait.

To give a familiar example of our meaning, let us suppose the Strait of Dover to be a Polar Strait, with the tidal currents always setting to and from it simultaneously, as we know they do in the English Channel and North Sea. Owing to the contraction of the channel at the critical point of the head or junction of the tides, the Strait of Dover would be permanently blocked up with ice-floes, and although for a few days in summer vessels might sail to within a certain distance of the head of the tide, both from the West and North, we do not think that any ves-

sel could ever hope to effect a passage through the narrow frozen strait. In this manner, we believe, Parry in 1820, and M'Clure and Collinson in 1851, were almost in sight of the line of junction of the tides, which they could not cross, and which, there is reason to think, no ship will ever cross in Banks' or Prince of Wales Strait.

3. *Wellington Channel and Queen's Channel.*—These channels lead, one on the south and the other on the north, into a wide channel (100 miles broad), containing Baillie Hamilton and Dundas Islands. The Atlantic Tide flows up the Wellington Channel, and the Polar Tide flows down the Queen's Channel, meeting in the centre where the channel is widest. This case of meeting of tides rather resembles what occurs in the Irish Sea, where the tidal streams meet in the widest portion, than the meeting of tides described at Dover, where the head of the tide coincides, as in Banks' Strait, with the narrowest portion of the strait. Under these circumstances, the head of the tide is not impassable, and accordingly, we know that the "Assistance" and "Pioneer," under Belcher and Osborn, did actually cross the head of the Atlantic Tide, and winter in Northumberland Sound in 1852, considerably to the north or Polar side of the head of the tide. In the following year they wintered in the pack of the head of the tide itself off Cape Osborn, and were subsequently abandoned by order of Sir Edward Belcher, who believed it to be impossible for them ever to be released.

This opinion was not concurred in by Captain Osborn, who, however, does not make sufficient allowance for Sir Edward Belcher's dislike to be "*towed by a junior.*"

"Almost any time between the 9th and 18th of August, the 'Pioneer' could have towed the 'Assistance' from Dundas Island direct to Cape de Haven; and indeed we know now, from a trip made by Captain Inglefield in a boat to that cape from Beechey Island, that water to that place would have then been found by the 'Pioneer' and 'Assistance.' The log-books of the 'Pioneer' and 'North Star,' and Inglefield's narrative, collectively attest this interesting fact.

"No one was surprised when the 'Pioneer' and 'Assistance' were caught by the drifting pack, and beset at a place called Cape Osborn, 50 miles north of Beechey Island; and with the early spring arrangements were made for the abandonment of all of H. M. ships in 1854."—*Osborn*, p. 344.

When we remember that the Grinnell Expedition, under De Haven, floated in the ice-floe, up Wellington Channel, nearly as far north as Cape Osborn, and back again into Lancaster Sound, we are led to the conclusion that in an ice-bound sea a vessel caught in the floe may approach to the line of junction of the tides; but that, even in a broad channel like that at Baillie Hamilton Island, if an unfortunate vessel should become entangled in the pack at the head of the tide itself, she is likely to remain there for ever.

We hope in our next Number to bring the American Expeditions under the notice of our readers, in connexion with the subject of the Atlantic Tides of Jones' Sound and Wellington Channel, and the drifting of the "Resolute" in the floe of Melville Sound; and shall take our leave of this interesting subject for the present with the following remarks upon the probable position of the lost "Erebus" and "Terror."

All the vessels hopelessly abandoned during the recent search were left at the head of the Atlantic Tide, viz., the "Investigator," in Banks' Strait; the "Assistance" and "Pioneer" in Wellington Channel; and Dr. Kane's vessel in Smith's Sound. The "Resolute," we know, floated out into the Atlantic, and probably others also, which, like her, were abandoned merely in the ice-floe, but not at the *head of the tides*. The Grinnel Expedition also floated freely out into Baffin's Bay, not having been caught along the dangerous line.

Is it too much to assert that the "Erebus" and "Terror" also lie, deserted by their crews, at some point of that fatal circle, either south of Peel's Sound, or at the bottom of Melville Sound, in some hitherto unknown channel, where, as in the Prince of Wales Strait, the Atlantic and Pacific Tidal Currents are destined for ever to counteract each others movements, and form a barrier of fixed ice-floe along their line of junction, presenting a gate always locked against the traffic in ships between the North Atlantic and Pacific Oceans?

While we write, it is likely that the sledges of M'Clintock are being rapidly prepared to solve this question, and although we do not claim the power of foresight, yet we believe that the theory of the meeting of the Atlantic and Polar Pacific Tides, which we have propounded in the foregoing pages, affords a rational and scientific ground for the confident hope we entertain that M'Clintock and his companions in the "Fox" will solve the mystery of Franklin's and Crozier's fate, by finding their abandoned ships (and, we trust, papers) locked in the ice of some ill-omened bay, like that of Mercy, within ten or fifteen miles of the junction of the Atlantic and Pacific Tides, in a channel south of Prince of Wales' Land.

Some competent authorities, including Captain M'Clintock himself, are of opinion that if a vessel could pass from Regent's Inlet through Bellot's Strait, she might easily make her way down to Pelly Point (160 miles) the farthest north-eastern limit of Collinson's remarkable voyage in the "Enterprise;" and the same reasoning would of course apply to Peel Sound, or a sound further west, between Osborn's and Wynniatt's farthests. Those who hold this opinion look with some confidence to the chance of the "Fox" accomplishing the North-West Passage by this route, and coming home through Behring's Strait along the north shore of the American Continent. To us, however, such a chance appears hopeless, for the following reasons: *firstly*, we do not think a vessel in such a narrow channel as this must be, could hope to pass the junction of the Atlantic and Pacific tides; *secondly*, the chances against effecting such a passage of the head of the tide are greatly increased in the ill-omened longitude 95° W., as we have shown in our former article; and *thirdly*, we believe that Franklin and Crozier attempted this very passage, and paid the heavy penalty of loss of lives and ships for the attempt; nor do we believe that the "Fox's" screw power could force her through.

We turn now to a highly interesting subject, brought under our notice by Captain M'Clure and Dr. Armstrong, and which would seem to prove that the set of the tides and oceanic currents must have been

similar to their present directions during the geological *drift period* of this dreary region.

This statement, we think, is rendered probable by the fact that the remarkable deposits of drift timber in the Polar Seas, to which we allude, are confined, so far as we now know, to the islands of New Siberia, off the coast of Asia, and to the western portions of Banks' Land and Prince Patrick's Island in the American Polar islands.

We shall give Dr. Armstrong's account of this remarkable phenomenon on the north-western coast of Banks' Land, although we cannot coincide in his inference that the forests which produced the timber once grew in Banks' Land. Indeed, on the same principle, we might be forced to admit that the specimen of *Cyprina islandica*, brought by Captain M'Clure from the summit of Coxcomb Range, Banks' Land (500 feet high), might once have lived and flourished among the pine-trees of Dr. Armstrong's forest, fulfilling the words of the poet:—

> "Piscium et summâ genus hæsit ulmo,
> Nota quæ sedes fuerat columbis:
> Et superjecto pavidæ natârunt
> Æquore damæ."

"We at once resolved to visit the spot, and in the evening I accompanied Captain M'Clure and a small party in the third whale-boat along the shore towards the place. I feel my inability to describe or convey a truthful idea of the bleakness, wildness, or desolate grandeur that met the eye on landing upon the part of the coast which led us to the desired locality. From the beach, a narrow vale extended tortuously into the interior, through a series of hills, rising range after range from 600 to 700 feet in elevation, unmarked by the slightest trace of vegetation. Their abrupt, nearly precipitous escarpments, separated from each other by deep and tortuous gorges, presented nothing to the view but sand and shingle; affording a picture of wild desolation and solitary grandeur, apparently matchless, and to be seen only in the distant regions of the Pole. On ascending one of these hills, about a quarter of a mile from the beach, on its side, about 300 feet high from the sea-level, we discovered the wood of which we were in search. The ends of trunks and branches of trees were seen protruding through the rich loamy soil in which they were embedded. On excavating to some extent, we found the entire hill a ligneous formation, being composed of the trunks and branches of trees; some of them dark and softened, in a state of semi-carbonization. Others were quite fresh, the woody structure perfect, but hard and dense. In a few situations, the wood, from its flatness and the pressure to which it had for ages been exposed, presented a laminated structure, with traces of coal. The trunk of one tree, the end of which protruded, was 26 inches in diameter by 16 inches; that of another, a portion of which was brought on board, was 7 feet in length, and 3 feet in circumference; and dense in structure, although pronounced then to be pine.* Other pieces, although still preserving the woody structure, had a specific gravity exceeding that of water, in which they readily sunk, from their having undergone an incipient stage of impregnation with some of the earthy products of the soil. Numerous pine cones and a few acorns were

* "A section of this piece of wood is to be seen in the Museum of the Royal Dublin Society, Dublin. To the obliging kindness of its able Director (Dr. Carte) I am indebted for a knowledge of this fact; who has also kindly informed me, that he submitted it to the examination of Drs. Steele and Joseph Hooker, both of whom pronounced it to be coniferous wood. The latter thought it of the white pine species; and one of the semi-fossilized cones has been pronounced by Dr. Harvey, Professor of Botany, Trinity College, Dublin, to be similar to the present Spruce of North America."

also found in the same state of silicification. The trunks apparently extended a considerable distance into the interior of the hill, and were bituminous and friable. Many of those which were embedded crumbled away on being struck with a pickaxe, which readily found its way into any part of them, rendering their removal impossible; some of them were in such a state of carbonization as to approach lignite in character. The whole conveyed the idea of the hill being entirely composed of wood. As far as our excavations were carried, nothing else was met with, except the loamy soil in which they were embedded; but the decay of the wood in some places appeared to form its own soil. The petrifactions, with numerous pieces of wood, were found strewn everywhere over the surface of this and many of the contiguous hills. Many specimens of these were obtained, varying from one to fourteen inches in length, the longest not exceeding five or six in circumference; they consisted of portions of the branches of trees. Some of them were impregnated with iron (brown hæmatite), had a distinct metallic tinkle when struck, and were heavier than other pieces, without the metallic impregnation or sound; they were simply silicified, the sand entering into the composition of the soil being siliceous or quartzose. Several smaller pieces of fresh wood were also found strewn about, which had not been, perhaps, subject to the petrifying influence of the water. The numerous small rills which issued from the interior, similar to those I had seen in the morning, flowed over the surface, and the constituents of the water, largely impregnated as it was with iron and sulphur, indicated from whence the metallic agency in the petrifaction was derived; this also possessed a dull yellowish-brown discoloration of the sulphur, and the stones everywhere over which the water flowed were coated with the same.

"On several of the neighbouring hills I observed distinct stratifications of wood running horizontally in a circular course, formed by the protrusion of the ends of the trunks of trees, to some of which the bark still adhered; and large pieces of this, cropping out and hanging loosely, frequently led in other situations to our detection of the wood to which the bark adhered in the soil. Any attempt to remove these with the hand or other slight means failed; and excavation ever established the fact that the hills were entirely composed of wood—the appearances met with being identical with those first mentioned. On subsequent occasions, when exploring the land several miles in the interior, observation led me to infer that a precisely similar state of things there existed. The situation in which our first excavation was made was in lat. 74° 27′ N., long. 122° 32′ 15″ W., and about a quarter of a mile from the beach. The distance, inland, whence similar appearances were observed, embraced a circuit from eight to ten miles in diameter.

"This discovery of wood in a recent and petrified state in a part of the world where we could have had no expectation of finding it, in regions whose blighting climate is opposed to the nurture of vegetable life, as evidenced in its scanty verdure, stunted Flora, and creeping dwarf-willow, its only arborescent production, could not but impart a feature of great interest to our voyage, and was a subject for geological research no less interesting than strange. Similar appearances, observed elsewhere, bear so striking an analogy to this singular discovery as to invest it with still greater interest, and I cannot forbear alluding to them here. In the explorations of the Ustiansk Expedition, under Lieut. Anjou, in 1821–23, on the South Coast of *New* Siberia, and in about the same latitude as that of our discovery in Baring Island, 'wood hills' were discovered composed of trunks of trees some ten inches in diameter, not very hard, of a black colour, bituminous and friable.*

"Hendenström observes:—'On the southern coast of New Siberia are found the remarkable Wood Hills. They are 30 fathoms high, and consist of horizontal strata of sandstone, alternating with strata of bituminous beams or trunks of trees. On ascending these hills, fossilized charcoal is everywhere met with, covered apparently with ashes, but on closer examination, this ash is also found to be a petrifaction, and so hard, that it can hardly be scraped off with a knife. On the summit, another curiosity is found, namely, a long row of beams, resembling the former, but fixed perpendicularly in the

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* "*Vide* 'Appendix to Baron Wrangell's Voyage,' translated by Major-General Sabine."

sandstone. The ends, which project from seven to ten inches, are, for the greater part, broken. The whole has the appearance of a ruinous dike.' Lieutenant Anjou, who likewise examined those Wood Hills, says: 'They are merely a steep declivity, twenty fathoms high, extending about five wersts along the coast. In this bank, which is exposed to the sea, beams or trunks of trees are found, generally in a horizontal position, but with great irregularity, fifty or more of them together, the largest being about ten inches in diameter. The wood is not very hard, is friable, has a black colour, and a slight gloss. When laid on the fire it does not burn with a flame, but glimmers, and emits a resinous odour.'

"I have also observed in one of the Parliamentary Blue Books, that a travelling party from H.M.S. 'Resolute,' when at Melville Island, on their return journey after exploring Prince Patrick's Island in 1854, discovered the trunks of trees embedded in a white sandy soil, on the same meridian as that of those discovered by us, but two degrees further north. One was four feet in circumference and thirty feet long, and another two feet ten inches in diameter; with several parts of similar trees just showing above the soil. Thus establishing a fact no less important than interesting, that throughout the wide extent of the Polar Sea, as far as observation has enabled us to determine, there existed at one period various and luxuriant forms of arborescent growth, in regions where nothing is now to be seen but desolate lands and trackless ice wastes."—*Armstrong*, p. 396.

The drift wood of the Siberian coast is supplied by the great Asiatic rivers, which flow north into the Polar Sea, and the Mackenzie and Copper-mine Rivers of America doubtless also contribute their share. At some remote pre-historical, though recent geological period, when the islands of the Parry group were some 500 feet lower than at present, the drift wood was carried, as at present, from the west to the east, and deposited in great quantity on the then western shores of the Parry Islands; and the fact that it has only been found in the western islands of these seas is a proof that, in that period, as at present, there was some obstacle to its further passage eastward. Now, as we have supposed the land to have been 500 or 600 feet lower than at present, the straits were probably more open than now, and, therefore, the obstacle to the currents eastward must have been in the sea itself. We think the impediment was the Atlantic Tide, which then, as now, met at these points the Polar and Pacific Tides, causing still or slack water at the head of the tide, and so producing the rapid accumulation of drift wood upon the western shores of the American Polar islands.

This view of the origin of the beds of drift wood is confirmed by the fact, mentioned by Dr. Armstrong, that floating logs of drift timber were met by the "Investigator" in the sea to the west of Banks' Land.

Some interesting, though not very precise information, respecting the geological structure of Banks' Land and Prince Albert's Land, is given by M'Clure and Armstrong. From M'Clintock's and M'Clure specimens of coal, preserved in the Museum of the Royal Dublin Society, and brought from Cape Hamilton and Cape Dundas respectively, it would appear as if the series of coal-beds which extend from Bathurst Island through Byam Martin's Island, and the whole south of Melville Island, were prolonged at the other side of the channel, into the north-east region of Banks' Land.

In the Princess Royal Islands, Captain M'Clure found nodules of

clay ironstone, partially converted into brown hematite; pisolitic brown hematite, and a grayish-yellow sandstone, which was also repeated in high cliffs at Cape Hamilton, where the coal was found. With these rocks occurs at the Princess Royal Islands the remarkable Devonian (?) fossil, *Terebratula aspera* (Schlotheim), and eastward of this locality, in Prince Albert's Land, Dr. Armstrong found coal-beds.

"About this time, during my excursions into the interior of Prince Albert's Land, while traversing one of the numerous gorges in which it abounds, I observed several slaty and dark clay formations on either side, more particularly at the angle of its windings, which were somewhat abrupt—the line of stratification inclining from the horizontal in some places to thirty-five degrees, the dip generally corresponding to that of the land. It was chiefly composed of dark laminated earth and shale; in the substance of the latter, and intervening between its layers, which were easily separated, thin laminæ of coal were discernible, and in some situations lines of it were observed in the formation at some distance—recognised by its well-known lustre. Sulphur in combination with iron was also found, and numerous specimens were obtained. Similar appearances I subsequently observed in other parts of this land; establishing, beyond doubt, the existence of coal, had we only had time and means to procure it."—*Armstrong*, p. 333.

These coal-beds must belong to a group distinct from those of the Parry Islands, unless they be supposed to be merely outliers resting on the Silurian Limestone of Prince Albert's Land.

The southern portion of Banks' Land, rising into the promontory of Nelson's Head, is probably composed of the same kind of upper Silurian limestones and shales alternating, which have given so peculiar a character to the shores of Lancaster Sound, as noticed by Parry and every subsequent Arctic voyager.

"The appearance of this coast, when viewed from the sea, standing on a north-east course from Cape Parry, is bold and lofty; it gradually falls away on either side from its southern extreme, or angle, in lat. 71° 5′ N., long. 123° W., extends in one direction to the north-west, and in the other to the east-south-east. The headland itself we estimated at 850 feet in height, but the summit of higher land could be seen in the interior, not less than 1000 feet; this presented a strikingly grand and imposing appearance, and to it the name of 'Nelson' was given, in remembrance of a hero not hitherto honoured by Arctic discoverers in the bestowal of their favours. The altitude gradually decreased on either side, until it ended in a low beach, some eighteen or twenty miles to the eastward, and then rose again in an undulating background, forming a continuous amphitheatre of ill-defined hills, so close to each other as to establish an apparent continuity of surface, but which are really separated by tortuous valleys and ravines. 'Nelson's Head,' therefore, as it is called, presents a bold, precipitous front, rising almost vertically from the water's edge. It is of limestone formation, the lower third of dark brown stratification, above which it assumed a lighter colour of reddish-yellow, such as a ferruginous coating might impart. This was surmounted by a dark grey columnar formation, much resembling irregularly-formed basaltic columns, with joints or fissures similar to what is usually observed in that formation; the whole capped by a covering of soil. The line of stratification dipped about 10° or 15° in an E.S.E. direction, and became lost as the land decreased in elevation. This dip was remarkable, and a prominent feature in the formation, but was less evident and more horizontal to the eastward, until finally lost in the dunes or low hills I have mentioned, where an abortive attempt at the same formation could be traced for some distance along the coast. A large quantity of *débris* had collected at its base."—*Armstrong*, p. 211.

The following account of the Princess Royal Islands, making due allowance for the extraordinary names given to the fossils, cannot fail to interest the geologist :—

"The smaller and more northerly one, is of very limited extent; being in length about 500 or 600 yards, in breadth 50 yards, its average height about 100 feet, inclining at an angle of about 45 degrees to the eastern shore of the Strait. On close examination it appears formed in irregular steps or ledges, as though, as may be readily imagined. from a large mass of matter in a soft state, slowly but steadily upheaved from the bed of the ocean, and partially falling away while emerging from the surface of the water. The greatest elevation is attained in the centre, where its western aspect is for a short distance vertical; on either side of which it inclines at a very abrupt angle to the westward, about 15°, so as to convey the idea (with the exception of the space I have mentioned) of its being on the principle of an irregular double inclined plane. This little island is rich in fossil remains, chiefly Corallines (*Encrinites* and *Pentacrinites*); the upper surface is composed of small stones and pebbles, with coralline ledges closely cemented to each other; and the rock beneath, which is composed of granulated, bituminous limestone, emitted an offensive odour when struck or fractured, and in some situations was plentifully studded with garnets. Numerous uni- and bivalve fossils, chiefly species of *Cyathophyllum*, *Turbo*, *Buccinum*, *Orthis*, and *Terebratida*, were likewise strewn on the surface, presenting good specimens of calcareous petrifaction.

"The second or larger island is situated about half a mile to the southward of the preceding, extending nearly due north and south for the extent of a mile, with a mean breadth of about 600 yards. It is elevated in the centre about 500 feet, from which it gradually decreases, but presenting throughout, except for a small space on its western aspect, where it is sloping, a bold and precipitous front, varying in elevation from 80 to 400 feet. The soil (if such it can be called) is entirely composed of a sandy, scoriaceous admixture of small stones and pebbles, with numerous volcanic boulders, embracing granite, gneiss, syenite, greenstone, fragments of basalt, &c., strewn over the surface—a few scanty tufts of withered moss attest the extent of its fertility during the short season of vegetation.

"The southern portion of the island appears to be one mass of fossiliferous remains of Zoophytes, Corallines, and a few uni- and bivalve shells, similar to those before mentioned. These fossils were found embedded in dark, bituminous clay or shale, of remarkable hardness in some places, but brittle in others, when there existed a ferruginous admixture of brown Hematite, of which the southern portion of the island is entirely composed. On advancing to the northward and towards the centre of the island. the fossils became less numerous, and soon disappeared, a dark laminated clay, of a dry, compressed, sooty-like structure, takes their place. Although there was here no distinct coal formation, yet on fracturing some pieces, a narrow carbonaceous line, with the coal lustre, could be discerned, such as it presents in a half burnt state, and this was more marked as the land became more elevated, of course displaying to view a deeper stratum of the earth's crust. The remainder of the outline of this island, for a portion of its western, and almost the entire of its eastern aspect, is composed of lime and ironstone, rising vertically, and containing a few fossils, extensively coated with depositions of sulphur and iron in combination, and emitting an offensive odour when fractured. The geological character of these islands from the specimens obtained is, therefore, associated with the Carboniferous era of the earth's formation."—*Armstrong*, p. 267.

The north-western coast of Banks' Land is composed of the same Carboniferous Limestone as is found in the north of Melville and Bathurst Islands, resting upon the coal-bearing sandstones in both cases The following description leaves little doubt on this point :—

"The Geological character of this coast line from Ballast beach to Cape Crozier, while it fully partook of an Arctic aspect in the highest degree, likewise presented some features of interest. The remarks formerly made with regard to the land in the vicinity of Ballast beach are applicable to the coast line as far as Point Colquhoun, which is the first

prominent point met with, is of limestone formation some eighty feet high, and was the first of a rocky character seen since rounding the southern extreme of the island. About five or six miles further to the eastward, a similar but somewhat more lofty point exists (Cape Wrottesley), the coast line intervening, forming nearly a straight line of barren, undulating hills. It is of similar formation (limestone), about 100 feet high, presenting an irregular and ill-defined line of stratification on its western side, dipping at an angle of about 15° to the north-west; but on its eastern side, as it loses its geological character, and becomes identified with the ordinary coast line, the stratification, instead of following the south-east inclination of the land, is thrown into a series of semicircular lines, which again become angular or zigzag before their continuity is established with the line of stratification at the highest point, about its centre. It is the most northern point of Baring Island, is situated in lat. 74° 30′; long. 121° 30′ 50″ W., from whence the coast line assumes an E.S.E. trending, until it again juts out in the fine bold headland of Cape Austin, which forms a grand and imposing feature in the outline of this dreary and unprotected coast. It is about 400 feet high, while a profile view gives it an inclination of some ten or twelve degrees, falling back in ledges with the debris forming a buttress at its base, extending upwards nearly a third of its height; yet, when viewed from the front, it appears quite vertical, and the desolate grandeur of its appearance was wonderfully striking from the perilous position whence we viewed it. Projecting through the debris, I could observe the more prominent angular portions of its lower formation, dipping in a slight degree from its centre on either side in a south-west and south-east direction, and they appeared to be composed of shale and a sort of slaty sandstone. Above, and surmounting the debris, it is of an ill-defined columnar structure, apparently limestone, fissured and broken up extensively, with no well-marked line of stratification; only what a slight change of colour here and there presents, which was uniformly brownish grey, with a ferruginous admixture interspersed throughout. Its general aspect much resembled that of Nelson's Head, but on a much smaller scale, and formed like it; a grand turning-point on this part of the coast. The outline assumes a convexity like the walls of a lofty fortress, the rocky structure being preserved for about 600 yards, until gradually lost in land of the usual hilly, irregular character. This takes a slightly crescentic form from its trending to E.S.E., and again shoots out in a north-east direction, completing the crescent of a shallow, shelterless bay, and ending in another bold headland, similar to, but somewhat less elevated than, Cape Austin. This fine Cape appeared identical, both in appearance and structure, with its confrère on the opposite side of this little shallow indentation, from which it is about three miles distant, and is possessed of the same convexity of outline, with much of its grand, imposing aspect, although in a less degree. It is elevated about 340 feet—its front, I may say, quite vertical, falling away on either side, identifying itself with the land like the other; and in structure it is of an ill-defined, broken columnar character, extensively fissured in a horizontal direction, resembling a state of progressive decay and dilapidation. Much debris was also collected at its base; its lower formation was slate and shale, laminated and fissured, and was surmounted by limestone of a columnar form, with well-marked lines of sulphureous and ferruginous deposit extending transversely along its front. The decomposition of this compound, probably taking place on its exposure, fully displayed the well-marked colour of both; which, when contrasted with the dark grey of the formation, imparted a stratified and divisional appearance to the whole.

"As circumstances did not allow of my visiting this Cape for more than a few minutes, my examination was necessarily confined to the debris, which entirely consisted of carboniferous limestone, in pieces or blocks varying in size from several hundred pounds weight to minute fragments. I found numerous specimens of fossil uni- and bivalve shells, embedded firmly in the limestone (embracing chiefly species of *Producta*, *Spirifer*, *Pecten*, *Cardium*, *Terebratula*, *Buccinum*, and a few others, the generic characters of which were not then determined), together with pieces of wood of various sizes, from portions of small twigs and branches to pieces two inches in diameter, embedded in the same manner as the shells. Some pieces were encrusted with a deposit of iron; others had a sulphureous covering, and emitted a disagreeable odour; but almost all looked black and charred, in an advanced stage of carbonization, as if partially burned; and displayed in numerous places the true lustre of coal. The limestone fissured readily

wherever the wood or shells were found in its substance—revealing them. Several pieces of very pure anthracite were picked up in the debris; and I have no doubt, had time permitted, it would have been found in greater abundance. I also remarked, that in the broken land intervening betweeen these two Capes, the escarpment presented a dark, carbonaceous appearance, similar to what is observed in the neighbourhood of the coal measures; and what I had previously met with in Prince Albert's Land; but I was unable to make a personal examination, from the critical nature of the position we occupied. Hence we may infer, had time permitted a thorough exploration of the locality, that results similar to those obtained in the hills near Ballast beach would have been obtained. From the identity, both in appearance and outline, of these two fine headlands, we may, I think, arrive at the analogical inference, that they are of the same geological character; not only as each other, but likewise as that of Nelson's Head, on nearly the same meridian, but at the southern extreme of the island."—*Armstrong*, p. 448.

We shall conclude our remarks upon the geology of Banks' Land by the following description of the rocks in the neighbourhood of the Bay of Mercy, where the Carboniferous Limestone was observed by Dr. Armstrong resting upon the coal-bearing sandstones of Cape Hamilton. He is, however, in error, in stating that the coal of this district is anthracite; it is identical with the coal found all through the Parry Islands, and was described by us in our last article on the Arctic Voyages, in a quotation from Captain M'Clintock's "Reminiscences" ("Nat. Hist. Rev.," vol. v., p. 44).

On the 17th, I proceeded with an attendant to the hills on the opposite side of the bay, to direct the removal of some specimens, and complete my geological examination of the land. In my course I visited two small islands in the centre of the bay; they possessed no interest, except in affording evidence of their having been at one period visited by the Esquimaux, in their migration along the coast. A few large masses of sandstone and clay-slate were collected on their summits, and a sort of embankment was thrown up around them, from the pressure of ice. The larger of the two is about one-third of a mile in length, 300 yards broad, and about thirty feet high in its centre, and has been apparently upheaved from the bed of the sea. The physical aspect of the land partakes of the same irregular, hilly character as other localities I have elsewhere spoken of. The soil is sandy, but in the ravines and valleys it is mixed with alluvium, forming a rich loam, which highly favours vegetation, and affords good pasturage for the hungry denizens of its wilds. Clay-slate, sandstone, clay-ironstone, calcareous and granitic pebbles, everywhere abound, and form the superficial covering of the land, with boulders of Plutonic origin scattered here and there over its surface, particularly on the summits of the higher lands. At the south end of the bay, and about 700 yards from the beach, which is flat and swampy, there is a remarkable limestone formation, rising almost vertically to the height of 500 feet, amidst a large collection of debris and huge masses of the parent rock—forming a formidable outwork at its base, resulting from ages of disintegration. Its character is mountain limestone, and contained fossils. The species were less numerous than those met with at Cape Crozier, Encrinites, Corallines, Terebratulæ, Pecten, Cardium, Producta, and a few others. Extending inland, and in a north-east direction, a chain of isolated table hills are met with, possessing a like general appearance and geological character. The northern coast of Baring Island, to the eastward of the Bay of Mercy (Banks' Land), is composed of a dark-brown sandstone, forming a chain of rather precipitous cliffs from 500 to 600 feet high, in which pieces of coal (Anthracite) have been found."—*Armstrong*, p. 527.

We have trespassed so long on the reader's patience, that we can only direct attention to some other matters of interest to the naturalist—especially Osborn's additional Chapter XVII., on the habits of the reindeer,

wolf, musk ox, Arctic hare, and lemming. We have no doubt but that this chapter, and his description of the habits of the Polar bear, in Chapter XIV., will be read with interest and profit, by both the naturalist and the general reader.

It would not be right to conclude without paying a just tribute of admiration to his clear and lucid style, and the manner in which he succeeds in winning and keeping his reader's attention throughout his book. Notwithstanding Sir Edward Belcher's insinuations respecting his brother Arctic writers, we have no hesitation in saying that we believe that Captain Osborn has preserved truth as well as English grammar in his narrative, and that there is no necessity for a writer to be either dull or spiteful in order to be believed.

On some points he differs, as we have seen, from his senior officer, but, as we think, never without giving some good reason for his opinions. The following passage illustrates both the sufferings of sledge travelling and the character of Sir Edward Belcher:—

"The Editor does not know of any sledge journey which can more vividly depict the sufferings which some sledge parties of sailors went through, than the one of which the following is a brief extract, from the daily journal of the officer in command, the present Captain George H. Richards, an officer second to none in the indomitable energy and skill he has displayed in the successful execution of every duty entrusted him in Arctic service.

"'On the 22nd Feb. 1854,' says Captain Richards, 'the temperature having ranged between 34° and 45° *minus* for the last four days, I started with two sledges, by Captain Belcher's orders, for Beechey Island, fifty miles distant. After eight miles dragging, the men were so very tired, cold, and miserable, that they hardly had patience to wait for their frozen meat being thawed; and that eaten, they threw themselves down in their blanket bags, half frozen as they were, to sleep. Next day (the 23rd) the thermometer registered 40° below zero, or 72° below freezing point!' The poor fellows dragged on as well as they could; but the Captain's hands were too cold, and his ideas too much engaged in attending to their safety, to write any journal beyond the hasty but graphic expressions in his note-book,—'It's distressingly cold?' 'the pork as brittle as resin;' 'the rum frozen!' So fatigued were many of the men, and so debilitated from constant suffering, that their stomachs rejected what food they attempted to swallow. On the 24th, the temperature had fallen to 74° below freezing point. It seemed as if human endurance could go no further; yet they tugged on, for anything was better than returning to the wretchedness they had left on board their ship. Their noon-day meal, called lunch, could not be partaken of; for the rum and the bacon were solid, and they were too cold to wait whilst either thawed. Passing by where the gallant Frenchman Bellôt had fallen a sacrifice in attempting to carry out the orders of Sir Edward Belcher (*vide* Blue Books), the worn-out and exhausted crews encamped at last off Cape Grinnell.

"Another night of sleeplessness passed, for the cold was too intense for the most tired to sleep.

"On the 25th Feb. the jaded crews made their way across Griffin Bay, the temperature still so low, and their sufferings so intense, that they could neither eat nor sleep,—a glass of grog and a bit of biscuit being all their food. On the next day the temperature was still 73° below freezing point; exhaustion was apparent with all the party, and Captain Richards had, as he says, 'serious misgivings as to whether he should be able to proceed.' On making the attempt frostbites became frequent and threatening; but a fresh gale from the north fortunately blew their sledges on, and in the evening they camped near Point Innes. On the following day Captain Richards and Mr. Herbert pushed on to the 'North Star,' at Beechey Island, for aid; and once arrived there, both he and his men fervently thanked their God for his protection through no ordinary suffering. It required a week's rest to restore his men to health and strength;

and perhaps the most painful part of this tale of suffering is, that it all arose from an idea upon Captain Belcher's part that he was gifted with prophetic powers as to a high range of temperature after the 22nd February."—*Osborn*, p. 170.

The probable position of the "Erebus" and "Terror" seems to resolve itself into the question,—Did Franklin sail down Peel Sound, or down a supposed sound leading into Victoria Strait, from the bottom of Melville Sound between Osborn's and Wynniatt's farthests? As Captain Osborn himself surveyed one of these limits, his opinion is entitled to be heard.

"The 7th of the month brought back the sledge party under Mr. Wynniatt; his turning-point was on the 26th May, at which time he was only fifty miles from the farthest point reached by a party under Lieut. Osborn from Griffith's Island. In both cases the land where each party turned back was strikingly similar, low, with off-lying shoals, and closely beset with stupendous ice. Since then, in the winter of 1853–54, two of Her Majesty's ships, the 'Resolute' and 'Intrepid,' were caught in the pack, and wintered due north of this intervening fifty miles of ground; and although the wind blew fresh from the north and north-west, they did not drift through any channel in a southern direction; the natural inference therefore is, that the land from Cape Walker in Peel Sound to the Prince of Wales Strait is continuous. The drift chart of the 'Resolute' and 'Intrepid' is strong evidence, at any rate, in favour of such a theory."—*Osborn*, p. 192.

We do not concur in the inference here drawn from the drift chart of the "Resolute" and "Intrepid," in the winter of 1853–54, for we believe that if a channel exists between Prince of Wales Land and Prince Albert's Land leading into Victoria Strait, that the Atlantic and Pacific tidal streams must meet at the north end of this channel, and that, therefore, it is permanently blocked up with ice, like Prince of Wales Strait, and that no current sets through it, as the tides destroy each other at both flood and ebb. If we might venture to draw any inference from Wynniatt's and Osborn's descriptions, it would be that the "stupendous ice" which besets this coast and the adjoining islets, is occasioned, as in Banks' Strait, by the existence of a channel in which the tidal currents meet—and it is also to be remembered that the unexplored coast is probably 150 miles, instead of 60, as there is reason to believe that Wynniatt's longitudes are seriously in error, in consequence of an accident to his chronometer; and it is well known that the log reckoned by men's feelings in a sledge excursion is always considerably in excess of the truth.

Captain Osborn's Appendix contains a most interesting account of a winter spent at Point Barrow by Captain Maguire, in command of the "Plover." The magnetic observations made by this officer have recently been published by the Royal Society, and the meteorological observations collected by the surgeon, Dr. Simpson, have been communicated to the British Association at their Meeting in Dublin, 1857.

The voyage of the "Enterprise," under Captain Collinson, remains to be put on record for the information of the public. It was, in many respects, one of the most important and successful of the Arctic voyages, either eastern or western; and our Arctic literature must be considered very incomplete without the publication of this volume.

Goodsir's "Arctic Voyage," which we have mentioned at the head of this article, is interesting, as a touching record of one brother engaged in a hopeless search for another, who doubtless perished with Franklin and Crozier; and also for the lively account it contains of life on board a whaler. The following sketch will convey an idea of his style:—

"We thought at the time that the fish were running right into the bay, and imagined that we could hear the distant sound of the guns, and the shouting of 'falls' about the ships, which could just be seen. We were in no very good humour at the idea of not being in the thick of it, but we had no reason to complain, as it turned out, for we learned, on our return, that the fish had never gone into the bay, and that scarcely any one had seen them on this occasion but ourselves. But we now had a good chance; a fish was seen beside the ice at no great distance from us, but beyond a 'fair start.' I have noticed a peculiarity about the whale, that if there is a piece of ice within sight it will run towards it, and come to the surface beside it. And when beside a floe it always rises beside its edge, and never appears at any distance from it. And, moreover, if there should be a crack or bight in the floe, it is ten chances to one it will rise to blow in it, in preference to the outer edge of the floe. This is well known to the whalers. Such a crack being now opposite to us, and at such a distance from where the whale was last seen, it was likely she would rise there next, and we pulled towards it. Here we lay for some minutes in breathless expectation, our oars out of the water, and the harpooner silently motioning with his hand to the boat-steerer which way to 'scull.' Up in the very head of the crack the water was now seen to be circling and gurgling up. '*There's her eddy*,' quietly whispers our harpooner: '*A couple of strokes now, boys,—gently,—that'll do.*' Looking over my shoulder, I could see first the crown, then the great black back of the unsuspecting whale, slowly emerge from the water, contrasting strangely with the bright white and blue of the ice on each side—then followed the indescribable hurstling roar of her blast. But short breathing time had she—for, with sure aim and single tug of his trigger-string, the keen iron was sent deep in behind her fin. '*Harden up, boys!*' he cries, and the boat is pulled right on to the whale, when he plunges the hand-harpoon deep into her back, with two hearty *digs*. The poor brute quivered throughout, and for a second or two lay almost motionless; then diving, and that with such rapidly increasing speed, that the line was whirled out of the boat like lightning. The usual signals were now made to the other boats that we were 'fast.'

"For the first few minutes the lines were allowed to run out without interruption, then, one, two, three turns were successively thrown round the 'bollard.' This had the effect of stopping her speed somewhat, but the line still ran out with a great strain. The boat's bow was forcibly pressed against the ice, and crushed through the underwashed ledge, to the solid floe beyond; the harpooner, sitting upon his 'thwart,' allowing the lines to run through his hands, which were defended by thick mitts: stopping the progress of the fish as much as he could, as the rest of the boats were still some distance from us. Every few minutes the fish seeming to start off as with renewed strength, the boat's bow would be pulled downwards, threatening to pull us bodily under the floe. But then allowing the line to run out, the strain was partly removed, and the boat's head again rose, but only to be again dragged downwards. Upwards of twenty minutes had elapsed since we had 'got fast,' and the strain now began to slacken, but it was full time,—we were drawing nigh the 'bitter end.' The welcome sound of a gun was heard, and in a few seconds, looking down the edge of the floe, we could see one of our boats with the well-known blue 'Jack' flying. A few fathoms more of line were rapidly drawn out, and then the strain suddenly ceased. We commenced hauling them in, and whilst doing so, could see a third boat 'get fast.' The rest of the boats were now at hand, and as she appeared at the surface, closely surrounded her, and busily plied her with their lances. It was in about an hour and a half from the time we first struck her, that we heard the distant cheers announcing her death. From the time the second boat had got fast we had been busily engaged hauling in our lines, and thus slowly approaching the cluster of boats round the dying whale. But long ere we had finished this they had succeeded in killing her, and she was lying safe and sound, made fast to the edge of the floe. The boats now

collected and prepared to tow the dead fish to the ship. This was even more tedious than hauling in the lines, but as I had volunteered to take my place in the boat, I said not a word, but tugged away at my oar in silence. Luckily, however, one or two fish were seen near us, in pursuit of which our boat and another cast off from those which were towing. The moment we were again in chase, fatigue and languor vanished, and we stretched to our oars as heartily as we had done when we first left the ship.

"We had a long, but a fruitless pull, and in the meantime a light breeze had sprung up, and we could see that the ship had 'cast off' from the land ice in the bay, and was working down towards the boats and dead fish. We pulled towards her at once, and I was not a little glad to be able to stretch myself on deck again, after nearly forty-eight hours' confinement to the thwart of a boat. A hearty welcome from the captain, who was not a little astonished to find me so fresh after my labours, and the tempting sight of smoking beefsteaks and *early potatoes* on the cabin table, soon made me all right, nor did I feel half so fatigued as I might have expected, and was later than even my usual time of retiring to my narrow berth in the little closet off the cabin, which was by courtesy termed the *Doctor's state room.*"—*Goodsir*, p. 88.

It is right to mention that the services rendered to science by Dr. Armstrong have been, to some extent, recognised, since his return, by the award made to him of Sir Gilbert Blane's Gold Medal, for his Medical and Scientific Journal, kept on board the "Investigator."

We hope in July next to return to the subject of Arctic Voyages, and, in the meantime, we would commend to the careful consideration of our readers the following question:—

Was it Franklin or M'Clure that discovered the North-West Passage?

The following statement of Captain Osborn will assist in the solution of this question:—

"In the following session of Parliament, a select committee of the House of Commons met, to take into consideration the reward due to those who had discovered and achieved the North-west passage; but, in the interim between the arrival of Captain Sir Robert M'Clure in England and the meeting of Parliament, news had arrived that Dr. Rae had obtained certain information of a party from Franklin's missing squadron having passed the intervening unknown space which lay between Barrow's Strait and the coast of North America. The duty of the committee became a somewhat more responsible one, in so far as it had to award the priority of discovery to Franklin or M'Clure, before the papers of the former came to hand.

"Lady Franklin, in a most able and touching letter, called the earnest attention of the Honourable Committee to the impossibility of arriving at any certain decision in the absence of all evidence as to Franklin's claim to the priority; and they, therefore, qualified the award by stating, very justly, that Captain Sir Robert M'Clure, in H.M.S. 'Investigator,' had discovered *a* North-west Passage, and successfully carried his followers from the Pacific to the Atlantic Ocean by that route, exhibiting himself an example of unflinching perseverance, courage, and zeal, which his officers and men nobly followed, and, to use the words of the Honourable Committee, 'that they performed deeds of heroism which, though not accompanied by the excitement and the glory of the battle-field, yet rival, in bravery and devotion to duty, the highest and most successful achievements of war!' Accordingly, a reward of £10,000 was granted to the officers and crew of H.M.S. 'Investigator,' as a token of national approbation; and, acting upon a suggestion thrown out by the Honourable Committee, there is every reason to hope that all this gallant ship's company will eventually receive at the hands of their Queen a medal which they will assuredly treasure far more than any pecuniary reward."—*Osborn*, p. 352.

Handbook of Zoology. By J. Van der Hœven, M. D., Professor of Zoology in the University of Leyden, &c. &c. In two volumes. Translated from the second Dutch edition by the Rev. William Clark, M. D., F. R. S., late Fellow of Trinity College, and Professor of Anatomy in the University of Cambridge. Vol. I., 1856 (Invertebrate Animals); Vol. II., 1858 (Vertebrate Animals). 8vo, with Plates. Cambridge: Printed at the University Press, for Longman, Brown, Green, Longmans, and Roberts, London.

The Professor of Anatomy in the University of Cambridge, wishing to introduce to his pupils a Handbook of Zoology, and not finding one that he could recommend, written in the English language, has been at the trouble of translating the well-known work whose English title stands at the head of this notice. Very similar were the reasons that induced the Rev. Dr. Clark to render this work into our vernacular; and those which, in 1827, induced Professor Van der Hœven to write these volumes.

It is much to be regretted, we think, that the preface to the first edition of this "Handbook" had not the effect of making somé of our native naturalists write a plain, intelligent, and cheap introduction both to Zoology and Zootomy. We hold, even with the two volumes before us, that such a book is still a desideratum, and we feel confident that there is among us some who could bring minds highly gifted by nature, and deeply learned by art, to bear upon this subject; and that the result would be equally creditable to them, and appreciated by those who could not afford money to purchase—nor, having purchased, afford time to peruse, such treatises as those of Van der Hœven and others.

"The Handbook of Zoology" chiefly consists of a catalogue of the classes, orders, families, and genera, into which the animal kingdom is divided. Introductory to each class we have a general sketch of the anatomy and development of some of its typical species; then comes the definitions of the class; of the various orders and families; then the diagnosis of the genera; a list of the more important sub-genera, and an enumeration of some of the more remarkable species, with remarks on their habits and economy; superadded to all being a very carefully written bibliography, thereby enabling us at once to refer to the very page on which the information sought for is required—whether that page be part of an elaborate monograph, or a short paper in some local periodical.

Perhaps a perfectly natural classification has not yet been discovered —it is, as Linnæus says, our first object and our last hope—but we do pride ourselves that if ever it is to be found, that day cannot be very far distant; not but that there will ever be some class like Cuvier's Radiata, into which may be bundled all the forms we feel in doubt about, the simple fact of their not belonging to any other class presupposing them to appertain to this. Van der Hœven takes as his leading idea the fourfold division laid down by his illustrious contemporary, Cuvier; not, it is true, following it to its utmost extent, but far more

so, however, than in the present enlightened age we could have thought possible. Indeed it would have been better if the translator had used some slight discretion, and embodied in the first volume well-known patent facts, which are very inconveniently alluded to by him in the preface to the second. The classification of the animal kingdom, as taught by Huxley, is one that recommends itself to all unprejudiced judges, and we would give here its leading details, in order that, making them a standard, we may be the better able to compare that given by our author in the present volumes:—1. Vertebrata = (α) Abranchiata (including Mammalia, Aves, and Reptilia). (β) Branchiata (including Amphibia and Pisces). 2. Mollusca, divided into—(α) True Mollusca, and (β) Molluscoidea = Polyzoa, Tunicata, and Brachiopoda. 3. Annulosa: (α) = Insecta, Myriapoda, Arachnida, and Crustacea. (β) Annuloidea = Echinodermata, Annelida, Rotifera, and the flat-bodied and nematoid worms. 4. Cœlenterata (including zoophytic and acalephoid forms). 5. Protozoa = Sponges, Rhizopods, and Infusoria (true). We shall begin to notice the last in this list, as it is the first with Van der Hœven; and, as we go along, shall add to the bibliography such recent information as may suggest itself to us, and has either escaped the notice of the translator, or been too recent to be included by the author.

The Infusoria of Van der Hœven includes the Rhizopods and true Infusoria. In the preface to the second volume Dr. Clark refers to an order of minute parasites, the Gregarinæ, which may be arranged after the Rhizopoda. They were discovered by Léon Dufour in the intestines of insects. Here we may mention a paper by Schmidt on their history and development, in the first volume (1855) of the "Transactions of the Senchenberg Society of Naturalists." Van der Hœven makes no mention of the sponges; but the observations lately published by N. Lieberkuhn, on the development of the fresh-water Spongilla, have induced Dr. Clark to mention (in the preface to the second volume) that many authors are *now disposed* to refer them to the animal kingdom. With such tardy confessions before us, we do not feel disposed to wonder at the time it took to convince the scientific men of the eighteenth century of the animality of the Corals. While refusing admission to the Sponges, the author includes Volvox and other Algæ among the animals. Many important details about the Infusoria are given in a paper, by Mueller, in the "Proceedings of the Royal Berlin Academy of Science" for 1856. Passing to the Cœlenterata, represented by the two classes Polypi and Acalephæ, we find arranged under the first, as a section, the Bryozoa. Van der Hœven errs in stating that this title was given by Ehrenberg in 1828, the truth being that J. V. Thompson's name of Polyzoa was bestowed in 1830, and Ehrenberg's not until 1834.

The position of the Polyzoa, as a section of the Polyps, is most unfortunate. We do not at all agree with Dr. Clark when he states that as many objections can be urged against placing this class near the Tunicata, as are urged against keeping it in union with the Anthozoid type, and we would gather from the work that the author will shortly be of the right way of thinking in this matter. We remark that both author and

translator appear to be alike ignorant of the researches of Busk on the Cheilostomatous Polyzoa. A passing line or two is devoted to an account of the Avicularia; but not a word is said of the equally curious vibracular organs. A new genus (Besselia) has been founded by Erman (*vide* Erman's "Archives of Russian Science," vol. xiv.) on *Gorgonia paradoxa* (*Esper*), remarkable for that the usual deposit of calcareous earth in the polypary is in it replaced by silica, forming cells filled with an organic fluid. We believe this to be quite an unique example among the barked Corals. Among the Actinina the genus Actinia is very much in the same condition as when Linnæus left it. The bibliography records, it is true, large additions to the species, and reaches from 1762 to 1835. But the last twenty years have not passed over without some labourers in this pleasant flower-garden, and Actinia has gradually developed into many new genera,—Anthea, Bunodes, Actinoloba, Sagartia, and others. We are informed that spontaneous fission does not occur naturally among the Actiniæ. If we include Anthea, as Van der Hœven does, with Actinia, we are pretty sure it does. It would be tedious to write up the bibliography since 1836; but we may just allude to Dr. Johnston's work, to the labours of Sir J. C. Dalyell, Gosse, Dana, and many others.

We come next to the second class,—the Acalephæ. At page 105 our author appears to incline to the idea of Kölliker, in considering the marginal bodies in the Medusæ to be auditory bodies. We are more willing to believe, with Ehrenberg, that they are eyes; and the researches of Gegenbaur go to confirm this. In going from the higher to the lower forms, from the Medusidæ to the Rhizostomidæ, great differences are found in their structure, and within the limits of the several groups there is an evident progression from a lower to a higher type of organization in this respect. The presence of a pigment spot in some of the higher forms makes it less surprising to find in some an evidently refracting lens, as in *Nausithæ albida* (*Geg.*) On this subject see Gegenbaur's paper in Mueller's "Archives" for 1856, p. 230. This paper being in the same volume as Lieberkuhn's paper on the development of Spongilla, should not so easily have escaped the translator's notice. In Wiegmann's "Archives," vol. xxii., 1856–57, we have an important paper, by Leuckart, "On the Medusæ of the Sea of Nice," a valuable contribution to their anatomy and natural history, and one by Gegenbaur, entitled, "Studies of the Organization and Classification of the Ctenophora."

The next four classes, i. e., the Echinoderms, the Entozoa, the Rotatoria, and the Annulata, go to form the "Annuloida." The preface to vol. ii., so often quoted, cites the latest memoirs on the Echinoderms. To the memoirs on the Entozoa we may add one of Diesing, in the tenth volume of the memoirs of the "Imperial Vienna Academy of Science" (1855); two by Wedl in the "Proceedings of the Vienna Academy" (1856); on the oral organs of the Nematodea; and on some new species of Nematodea; to the memoirs on the Dendrocœla among the Annulata, add that of Schultze, on the Land Planariæ from Brazil, in the "Trans-

actions of the Society of Naturalists of Halle," vol. iv. part 1. At the end of the Annulata we find the genus Sagitta. Upon the elaborate memoir in the last-mentioned Transactions by Gegenbaur, we learn that in the development of the ova the most noticeable points are,—the division of the yolk produces long pyramidal cells, having their base at the surface and their apex towards the centre, which retain this form even after the formation of the embryo has commenced; the origin of the intestinal canal is contemporaneous with the division of the yolk, and it appears at first as a central cavity of the yolk, the communication with the exterior being established at a later period; the development from the egg is completed without any metamorphosis, not even cilia being produced on the surface of the embryo: hence the type of development is totally different from that of the Mollusca, the embryo being formed without metamorphosis, without a velum, or even the temporary presence of cilia. This last circumstance distinguishes it from the Annelides and Platodes, but points to the analogy with the Nematodes, with which also the mode of development agrees best throughout, except as regards the singular form of the segmentation cells and the first formation of the intestinal cavity. These peculiarities tend to confirm the views of the first observer, Slabber, who placed Sagitta among the worms, but as a peculiar group—dart-worms, which Gegenbaur would intercalate between the Nematodes and Annelides. This paper is illustrated with a nicely executed plate, and is a most valuable memoir, it being only by the careful tracing out of the development of such doubtful genera as Sagitta that we can ever hope to arrive at their natural position among the families.

To come to the Annulosa proper, we first arrive at the Insecta. We do not at all agree with the division adopted by Van der Hœven: he makes twelve orders—Myriapoda, Thysanura, Parasitica, Suctoria, Strepsiptera, Diptera, Hymenoptera, Lepidoptera, Neuroptera, Hemiptera, Orthoptera, and Coleoptera. How much better and simpler would it have been to have separated the first order altogether from true insects, and then to divide Insecta into five orders. In the preface to the second volume we are informed that the author does not insist on the distinctness of the fifth order, agreeing, with modern authors, to place it among the Coleoptera. It would have been equally well if the translator had referred the Suctoria to the Diptera (see Haliday's most important paper on this subject, "Proceedings of the Dublin University Zoological Botanical Association," 1856); the Thysanura and Orthoptera to the Neuroptera; the Parasitica to the Hemiptera. On the Insecta the author does not appear to be up to the English literature; with the exception of Westwood, he hardly mentions a single name. We may, perhaps, add a paper by Schiödte on the structure of the thorax in insects as a ground of classification, in the "Proceedings of the Danish Royal Society" for 1855. So many important papers have lately appeared in the Proceedings of the various British and Continental Societies that we cannot afford room even to allude to them.

In the next class, that of the Arachnida, is placed the order Polygo-

nopoda. We would mention a paper by Krohn on the heart and circulation in Pycnogonidæ. This organ, the existence of which has been negatived by Quatrefages, was demonstrated by Zenker in *Nymphon pallipes*. A very particular account of its structure and of the phenomena of circulation is given in this essay, which will be found in Wiegmann's "Archives" for 1855–56. On the order of Pseudoscorpiones, we have a very elaborate memoir by Menge; he gives a very full and elaborate account of the internal and external anatomy of this minute tribe. He divides the family into five genera, and enumerates fifteen species, of which seven are found in amber, and eight recent. *Vide* "Transactions of the Dantzig Society of Naturalists," vol. v. part 4, 1855.

To the many memoirs on the Scorpions, we must add one by Dufour, which appeared in the "Memoires presentes par divers Savants a l'Academie des Sciences," &c., vol. xiv., 1856. This essay, based on the examination of nine different species, under circumstances more favourable than preceding observers could command, offers, doubtless, the most complete and trustworthy account that has yet appeared of the structure of this family, which is peculiarly interesting from its highly complicated organization, and because of the light it throws upon the rest of the class, in which the parts become more crowded and confounded, so as to disguise their homologies. Dufour, having traced the origin of the nerves which supply the mandibles and chelipalps to the thoracic ganglion, accordingly denies the existence of antennæ in this tribe, and, by inference, in the rest of the Arachnida. He impugns the propriety of the generic divisions which have been founded on the number of the eyes; he maintains that three ocelli on each side is the constant number in various species to which more than this have been attributed; and he states the curious fact that, in the *Scorpio Europæus*, which has but two at each side when full grown, there are three with their distinct optic nerves in embryo, but two of these contiguous, and one of them subsequently disappears by abortion.

Passing on to the Crustacea, our attention is arrested by the very meagre account we get of their metamorphosis, if we except a few lines added by the translator from Darwin. The whole subject is dismissed in about half a page, and in this short space many errors, both of omission and commission. No reference is made to the fact that *Zoea taurus* was figured and described as far back as 1778 by Slabber, a countryman of our author; and we are informed that it is to John Thompson, an Englishman, that science is indebted for the discovery of the change of form in Decapods.

To the bibliography of the family Ostracodea add a new memoir by S. Fischer, in the "Transactions of the Royal Bavarian Academy of Science," vol. vii. Van der Hœven (differing from Erichsen and others) considers the two large jointed appendages, especially useful in swimming, as posterior antennæ. There is an interesting paper by Liévin, in the "Transactions of the Dantzig Society of Naturalists," vol. v. part 4, on the "Dud" or Fezzan worm, the *Artemia oudneyi* of Dr. Baird; this

minute crustacean abounds in the Natron Lakes of Fezzan. Another species, *A. salina*, is common enough in our own salt works. Liévin decides that Artemia is not a natural genus, and accordingly refers the species to Branchipus. Close after this family (Branchiopoda), our author would place the Trilobites, the resemblance to Isopoda appearing to him rather an analogy than a real affinity. To the family Oniscides add a review by Dr. Kinahan of the genera of Terrestrial Isopoda (Oniscoidea), with descriptions of all the known British species and genera (see "Natural History Review," vol. iv.).

We were disappointed at not finding any allusion to the discovery of blind Amphipoda. Yet, so long since as 1851, the genus Niphargus, appertaining to the family Gammaridæ, was formed by Schiödte for some Crustacea, in which the eyes were wanting; one species, too, of this genus having been found in England (near Maidenhead, in 1851), the account, therefore, might have reached the translator's ears (*vide* "Proceedings of Royal Swedish Academy" for 1855; or vol. iv. "Natural History Review," Notices of Serials, p. 9, and p. 41, 4, with a plate). In the "Proceedings of the Royal Academy," just referred to, there is an important paper by Liljeborg on the marine Crustacea of Kullaberg in Scania, the new species being chiefly Amphipods.

In that most useful, in an economic point of view, of all the orders of the Crustacea—the Decapods—there is an oceanic genus made by Milne Edwards for the reception of a single species, i. e. Sergestes. Time passed on, and a second species of this oceanic genus graced the Royal Danish Museum: recently, however, a sailor voyaging to the Brazils captured no less than nine new species, which have been (with the other two) described by Krœyer in the "Proceedings of the Royal Danish Society" for 1855. As eight out of the ten new species were found on the one spot, about 42° N. lat., and 21° W. long, Krœyer thinks that this must be the metropolis of the genus. It is, at the least, a curious centre of creation, far out at sea.

The last class we have to notice before coming to the Vertebrates is that of the Mollusca, which are divided into three classes, Tunicata, Conchifera, and Mollusca. In this the author follows Lamarck, and although he attempts to justify the using of the same word in a general and also in a special sense, yet we would most decidedly advise no one to follow him in so doing; and we surmise that the reverend translator will find it rather absurd to have to tell to his pupils at one time, that Mollusca consist of Tunicates, Conchifers, and Molluscs; and at another time, that Mollusca consist of Cephalopoda, Gasteropoda, &c.

We have before mentioned, that though acknowledging their close affinity to the Tunicata, yet Van der Hœven separates the Polyzoa from the Mollusca. We need hardly add that the Brachiopoda are placed with the Conchifera. We do not know of any recent researches on the Tunicates not noticed in these pages, except, perhaps, one by Allman on the Homology of the organs of the Tunicata and Polyzoa, in the "Transactions of the Royal Irish Academy" for 1852, vol. XXII. Da-

vidson has not yet finished his elaborate monograph on the Brachiopoda.

Among the Lamellibranchiata there have been numerous papers scattered through the British and foreign serials. Clark has placed us under many obligations by the publication, in a single octavo volume, of his valuable malacological essays on the British Mollusca; while the American conchologists have added vastly to the amount of new species, and Dr. J. E. Gray has kindly prepared genera and sub-genera, into which they "drop" quite naturally. The "Shells and their Inhabitants" of the Brothers Adams still makes its occasional appearance, enriching doubtless in a high degree the purse and pocket of the benevolent publisher; but up to the present without any sign of coming to a conclusion. Then we have weighty contributions from that vast shell-house, the "Museum Cumingii," monthly making their appearance in doubtful Latin, in the "Proceedings of the Zoological Society of London," and shortly afterwards rendered useful through the philanthropy of a Reeve, dressed in decent English—that would be better if it did not exactly follow the Latin—and embellished with first-rate lithographs; and last, but not least, we have British Museum Catalogues, and *a* Catalogue of *the* Catalogues; some of them just published; others in the press. We do not hold Van der Hœven or Clark liable for this great mass of matter, and, therefore, we do not grumble at this part of the bibliography not being quite up to the ever increasing standard of the day. Among foreign contributions we would notice the prize essay of Cailliaud "On Boring Mollusca:" he considers the operation to be purely mechanical in Pholas, Teredo, &c., while he allows that others, as Saxicava, Gastrochœna, &c., bore by means of an acid (*vide* "Transactions of the Dutch Scientific Society of Haarlem," Part xi. 1856). The recent discovery by Troschel of the existence in Dolium of free muriatic acid, settles the question of acid, occurring in some Molluscs at least, for ever. The very strange genus Furcella wanting a trace of the valves, so universal a distinctive mark of Lamellibranchiata, is not mentioned.

The development of Chiton is not alluded to, and though the various stages have not been satisfactorily observed or recorded, yet the papers by Clark in the "Annals of Natural History," and that by Loven in the "Proceedings of the Royal Swedish Academy" for 1855, are well worthy of a perusal. The species selected by both these observers was *C. cinereus* (*L.*); the young larva moves about by the aid of a circle of cirri, which would appear to correspond to those on the velum of other young Gasteropoda. The number of ova discharged by a single Chiton is upwards of 2000, and are about 1–100th of an inch in diameter. Our author places the Chitons, without any hesitation, among the Cyclobranchiate Mollusca, as surmised by Cuvier; and the development determines this position as the true one. As Clark's observations were very hastily made, the details were by no means as fully elaborated as we could wish, and we know no subject that stands more in need of original investigation, and that would be more likely to reward the patient observer. Loven's memoir may be taken as a pattern to work by.

With regard to the Cephalopoda, although the translator has recorded a good deal of what is known respecting the Hectocotyli, yet we would have expected him to have alluded in vol. ii. to the very important memoir in the "Transactions of the Royal Danish Society" (vol. iv. part i. 1856), by Steenstrup, entitled, "The Structure of the Hectocotylus in the genera Argonauta and Tremoctopus, illustrated by observations on similar structure in the Cephalopoda in general." This memoir proves that the phenomenon is not confined to the two genera named, in which it is most fully developed. Steenstrup is of opinion that it has not only a physiological value, but also a systematical significance. The following Table of the most striking differences in the mode of its determination will illustrate this :—

I. Octopods.—These possess in the highest degree the faculty of reproducing lost arms, and parts of them. A. Hectocotylus, deciduous, colourless, developed in a sac. a. Hectoc, the third arm of the left side = ARGONAUTA. b. Hectoc, the third arm of the right side = TREMOCTOPUS. B. Hectoc, persistent, coloured, free, the third arm of the right side = OCTOPUS; HELEDONE. II. Decapods.—Destitute of the faculty of reproducing the arms. A. Myopsidæ.—The Hectocotylus developed. a. In the first arm of the left side; *a*, only the middle of this arm; the first of the right in some degree similarly affected = ROSSIA. *b*. In its whole extent, and this arm only = SEPIOLA. b. In the fourth arm of the left side. *a*, at the base only = SEPIA. *b*, at the tip only = SEPIOTEUTHIS; LOLIGO. *c*, in its whole extent, LOLIOLUS. B. Oigopsidæ (*D' Orb.*) No Hectocotylus arm developed, as far as is known. The genera OMMATOSTREPHES; ONYCHOTEUTHIS; LOLIGOPSIS.

It would appear that Aristotle was familiar with this phenomenon, as regards the *Octopus vulgaris* of the Mediterranean. This leads us to remark that our common Loligo is not the *L. vulgaris* of Lamarck, as stated by Forbes and Hanly; neither is it the *L. magna* of Rondelet, as Leach and a few others thought. Steenstrup accordingly has adopted the trivial name of Forbesii for the *L. vulgaris* of E. Forbes and S. Hanly. On leaving the Mollusca, we may state, that our author, not satisfied with the order of succession of the families of the Lamellibranchiata, would, had he to rewrite his volumes, entirely remodify this order.

The second volume begins with the Fishes. Van der Hœven says, very truly, that the arrangement of the fishes is attended with great difficulties, and it seems to be rather the avoidance of what is frail, than the attainment of what is perfect, that the most earnest investigations and the most learned disquisitions have yet to offer; and there are very few, we hope, presumptuous enough to say 'No' to this; and there are very few who have laboured in this particular department but have speedily found out its verity. On the first step of the threshold we meet with an Amphioxus—that most imperfect of all vertebrate animals—and as we leave this abode, tenanted by Neptune's army, we stumble over a Lepidosiren vainly imploring us to bore a hole in his nose, and he would crawl away. By-the-by, it is a curious fact, and one we have on fair authority, that if into the breathing holes of these creatures (*L. annec-*

tens), when buried in the soft mud of the Gambia, a little dust is thrown, it is at once blown (we were going to say sneezed) out,—an odd thing for a fish to do.

To the bibliography of the *Malacopterygii apodes* add a memoir by Kaup in Wiegmann's "Archives," vol. xxii., entitled "A Synopsis of the Families, Genera, and Species of Eels." To make the family a natural one, Kaup considers it necessary to restrict it to the families Ophisuridæ, Anguillidæ, Muraenidæ, Congeridæ, and Synbranchidæ, thus excluding the Gymnotidæ and Leptocephalidæ, as well as Ophidium and Ammodytes. The genera Alabes, Saccopharynx, and Gymnarchus are also excluded; but as to their true systematic place the author is not yet decided. Several other papers by Kaup, in connexion with fishes, follow the one we have just alluded to, in the same volume of the "Archives."

The genus Tetragonurus (*Risso*) is placed among the Mugilidæ;—a recent paper by Mettenheimer, in the "Transactions of the Senchenberg Society of Naturalists," vol. i., 1854, in which he goes very minutely into both anatomical and histological details, would favour this position. Although the hard scales recall the Lepidosteus and others, still there is nothing to warrant its being placed with the Ganoids.

An important memoir, by Schultze, "On the Embryology of the Lamprey," appears in the "Transactions of the Haarlem Society," Part xii. 1856; and one on "Analytic Icthyology," in the "Memoirs of the French Academy of Science," Part i. for 1856, by the now veteran Dumeril. The first chapter in this latter memoir comprises a sketch of the natural history and physiology of the class; the second treats of the general principles of the classification, the rest of the volume being given to the details.

Van der Hœven thinks that those writers who would divide the Reptiles into two classes—the name Amphibia being given to the Batrachians, and Reptilia being restricted to the Ophidians, Saurians, and Chelonians—go too far. We think, however, with De Blainville, C. L. Bonaparte, Bell, and others, that such a division is imperatively called for, and would place the one among the Vertebrate Abranchiata, and the other among the Vert. Branchiata.

There is an interesting paper by Molin on the heart and circulation of the Boa Constrictor, with twelve plates, in the "Transactions of the Venetian Imperial Institute of Science," vol. i. 1856. On the development of Tortoises we have the first instalment of Agassiz's great work, but can give no opinion of it, having only examined the plates, save that its author's name is a guarantee for something good; and from the plates we would judge it a valuable contribution to the embryology and development of the Chelonia. In the twenty-first volume of Wiegmann's "Archives," there is a synopsis of Amphibia by Peters, of some merit: in it many new species are described.

The birds are divided into six orders, i. e. Natatores, Grallatores, Gallinæ, Scansores, Passerini, and Raptores.

In the introductory sketch of their development and anatomy we

have a good deal of information given us about feathers; but perhaps the most important contribution that has been made to science on this subject is by Engel (*vide* "Proceedings of the Vienna Imperial Academy of Science," vol. xxiii.), "On the Development and Arrangement of Feathers." He tells us that the arrangement of the feathers is connected with the progress of segmentation in the embryo, which precedes the development of the several parts, each of the divisions formed on the surface of the body by these processes becoming clothed with feathers independently of the other. In each division the development of the capsules proceeds from the circumference towards the centre, the arrangement of them following the outline more closely in proportion as they approach to this boundary. The formation of a series of capsules commences with the appearance of a thickened streak, which afterwards break up into divisions corresponding to the number of feathers. In each pair of contiguous streaks the roots are developed alternately, so that each capsule in one series is opposed to the space between two in the next, giving rise to a great variety of complicated geometrical figures. The feather appears in the first instance as a nearly rounded collection of cells, which becomes divided subsequently into two spherical masses. The superficial cells coalesce with one another, both longitudinally and transversely, so that the feather acquires a fibrous structure. The growth of the feather takes place from the end by the development of a terminal bud, which forms a new one by transverse fission, and so on till the end of the feather has attained a certain degree of slenderness. Similar terminal buds then appear on the separate vanes of each feather, and these, by continued transverse fission, develop new terminal and lateral buds, which last constitute the bilateral fringe of the individual vanes. In the course of these processes there is no formation or repetition of cells, in the ordinary sense of the term.

We are not sufficiently acquainted with bird literature to notice omissions of any great importance; but among recent works, of which we observe no notice, we may mention Cassin's "Birds of Texas, California," &c.; Count Henry von der Muehle's "Monograph of European Sylvidæ." This latter is but a posthumous fragment of an intended great work. Philip Lutley Sclater's work on the "Tanagers" is in process of publication; and we have speedy promise of the first part of Dr. Brewer's great work on "American Oology." "Naumannia," too, the organ of the German Ornithological Society, of which Williams and Norgate are the London publishers, still makes its appearance every second month,—quite the perfection of a periodical: in its pages the reader may revel in bird lore, and find abundance to gratify his appetite in perusing the accounts of this most attractive class of living creatures.

In the classification of the Mammalia full use has been made of Professor Owen's views respecting the dental characters of the class; and the author regrets that the same Professor's memoir on the characters, principles of division, and primary groups of the class, should have been published too recently to admit of that general discussion of it by zoologists which he thinks ought to precede.

It now but remains for us, having so briefly glanced at the classification adopted in this work, to pronounce our opinion as to its merits. Before doing so we would observe, that for some time past we have been quite in a despairing mood about hand-books of zoology. Suppose a young, ardent student, who fancies he is to become a second Cuvier after a six months' course of lectures, puts to us a question that any fool might ask, but even a wise man cannot answer, i. e. "Recommend me a good elementary book on zoology, one that will begin at the very beginning, and teach me step by step the knowledge that I want." We confess that this query puts us completely *hors de combat*. Supposing expense to be out of the question, and we recommend Owen's two volumes of Lectures—well, in the one volume he would be all at once beyond his depth, and in the other he would learn a good deal that he must unlearn very quickly; and so he loses both time and patience. Then Rymer Jones's "Outlines of the Animal Kingdom" is, though an agreeable and withal nicely written book, very deficient in many most important subjects. That the Professor of Anatomy in our sister University of Cambridge must have felt this difficulty is quite evident from the fact that he has translated these volumes, and if he means them to be used as a class-book, even by the enlightened alumni of his University, we fear he will find himself wofully disappointed. True, if they would buy the volumes for the sake of the hundred pages or so of introductory chapters, they would and should acquire much useful knowledge; but the rest would be to them like a huge dictionary, into which they might sometimes look with feelings of reverence mingled with dread. So far, it will be evident, we do not consider this work as any great acquisition to our list of *elementary works;* but still we do regard it as an acquisition, and that a most important and valuable one, to the number of our scientific manuals.

While we would not put this work in the hands of a tyro, yet we would cordially recommend it to every one who either teaches zoology or has made some progress in its study. Few have had more experience in teaching than the Professor of Zoology in the University of Leyden, and these volumes contain the result of all his experience, ready to be used by every one who is capable of doing so.

Is information wanted on any portion of that living army of species which inhabits our globe? Well, here, within the compass of these volumes, it is to be found, or at least a reference to where it may be found is given; and naturalists who are busily employed on some special subject will find this work quite a necessary one on their book-shelves. We know that by such it is very much esteemed on the Continent, and we have no doubt whatever that, when known, it will be equally well thought of here. We shall be disappointed if it does not—to use Professor Clark's words, "from its scientific value and the interest of its historical and other notices, as well as from the continuous references to the works of original observers—secure for itself, beyond the walls of Universities, a reception not unworthy of its author's great name."

The Rambles of a Naturalist on the Coasts of France, Spain, and Sicily. By A. de Quatrefages, &c., &c. Translated (with the Author's sanction and co-operation) by E. C. Otté, Honorary Member of the Literary and Philosophical Society of St. Andrew's. In two vols., 8vo. London: Longman and Co. 1857. Price 15*s.*

Thanks to Miss Otté, we have now before us in an English dress the essays by M. Quatrefages, which some years since charmed the readers of the "Revue des deux Mondes;" and before proceeding for a short spacc to notice the "Rambles," we would give our meed of praise to the translator for the excellent manner in which her task has been performed. We meet with no French idioms, no mistranslated passages, but, on the contrary, we have a faithful rendering of the original into good sterling English, quite delightful to read. It may appear an easy task to translate good French into good English, but that it is not so in practice we have abundant demonstration in many a translation that is issued by our British press. This English edition being dedicated to an illustrious Scotchman, we must not object to Scottish local names being applied to some common shells, &c.

Where so much is good, we know not what specially to commend. Living in a metropolis that stands on the borders of a bay, which, had it as blue a canopy, as brilliant a sky, might almost vie with that famed one of Naples, we could not resist a smile when we read of our author packing up his books and instruments, and wending his way to an ocean, which he was for the first time to behold, and for the first time to understand the difference between the ebbing and flowing of the tides.

The impression that a first sight of a thing so noble as the mighty sea had on our author is simply yet elegantly told. On reading it, we closed our eyes for a moment to recollect if we could think of any account of *a first* sight of the sea; and though we could think of none, yet imagination led us to a far distant time, and to a far distant country, and we saw a few toil-worn men at early dawn leaving a poor Indian village, and with faces in which hope seemed to conquer weariness, betake themselves to climb the adjoining mountain side. Soon they emerged from the tangled forest, and there was nought before them but the bare mountain top: here they halt, and one, evidently a leader, ascends alone, and then we see him sink down upon his knees, as if in an ecstacy of delight! Yes, after much weariness, and labour, and pain, and toil, the daring, the desperate Vasco Nuñez de Balboa for the first time beheld below him a vast chaos of rock, and forest, and green savannahs, and wandering streams; while at a distance the waters of the wished-for ocean glittered in the morning sun. "The imagination," says the gifted Irving, "delights to picture forth the splendid confusion of his thoughts!" Was this the great Indian Ocean, studded with precious islands, abounding in gold, in gems, and spices, and bordered by the gorgeous cities and wealthy marts of the East? or was it some lonely sea locked up in the embraces of savage, uncultivated

continents, and never traversed by a bark, excepting the light pirogue of the savage? But we must leave imagination, and return to our volumes. Space would not allow us to note all the passages worthy of the reader's study—for there are many such; in some we find difficult subjects so clearly and simply explained as to make it worth one's while to commit the passages to memory; and we think to a lecturer the perusal of this work would be of great importance, as it would exhibit original information popularly yet scientifically given.

In the introduction our author says, that, when speaking of scientific matters, he never allowed himself in the slightest degree to sacrifice the substance to the form, being as anxious to act the part of the zoologist as rigidly as if he had been engaged in compiling a work for his brother zoologists. While we grant that he has generally been very successful in so doing, yet there are some passages in which we think there is a slight departure from the above-mentioned intentions; and perhaps the most unscientific writing in the whole of these two volumes is the author's description of the treasure of the Sacaviron, a narrow channel which separates Meule from Ile-aux-Oiseaux, in the Archipelago of Chausey. We have described in glowing language a great many very common things. We are told that there we would find *the* Buccinum, and *the* Rissoa, and *the* Turbo, as if, forsooth, species and genus were all one. But if species and genera are confounded, so are species and families. For we read that the rocks are "clothed with a mamillated stratum of simple Ascidians; a *species* of Molluscs which live and die without ever having moved from the same spot." Well, in these days of embryological discovery, this latter statement is too bad, and we wonder what the author could have been dreaming of! As early as 1835, some years before M. de Quatrefages went to Chausey, the tadpole larva of the Ascidiadæ had been discovered and described; and the truth here is so much stranger than fiction, that its narration would have heightened the interest that attaches to these curious creatures. Again, M. Quatrefages does not write as if he knew—which he surely must—that the Botrylli are compound Ascidians. He says:—

"From the ceiling hung down, like so many girandoles, transparent Clavellinæ, and the bright Botrylli, whose conglomerated masses exhibit the colours and translucence of the agate. The smoother stones were all covered with compound Ascidians, which were spread over the surface in shining green, brown, red, or violet patches, interspersed with markings of geometrical regularity, which severally indicated the different family groups of these singular beings."

We are told that the Thetys is a kind of a sea-slug, belonging to the Gasteropoda, but that it has no test—it would have been better if the translator had given us the word "shell" instead of test, which is one very likely to mislead. When the author writes about his favourite Annelids, then we drop our pen—there is no use keeping it in our hand to mark passages that display little ignorances, for there are none of them. Here we revel among descriptions of Sabillas and Terebellas, and of Matildas and Herminias.

"Here no microscope or lens can aid us. Do but drop into a basin of sea-water this fragment of rock and this old shell, whose surface is covered with Serpula, Vermilia, and Cymospires; observe the prudent caution with which that little round plate rises above each tube, which it is designed to close hermetically, so that your eyes cannot penetrate to the interior; this is the hall-door of the house! See! it is moving,—the animal will soon show himself. Look, and you will see below that operculum, bud-like patches of dark violet or rich carmine in one part, and of a blue or orange tint in another; while still further on appear tufts of every hue. See them expand little by little, until they have displayed the whole of their thousand coloured branches, similar in form to a plume of ostrich or marabout feathers. You are a witness of the evolution of veritable flowers, more beautiful by far than the blossoms of our gardens, for these are living flowers!"

While the principal part of these volumes is devoted to the consideration of marine zoology, yet we have now and then little sketches of some terrestrial animals.

Among the mammals that lived on Brehat, we find two representatives of the genus Mus, i. e. the mouse and the black rat,—Brehat being one of the very few places in Europe where this same poor black rat reigns. And we are really sorry to find that M. A. de Quatrefages thinks it very likely that that great pirate, the Norway, or brown rat, will traverse the narrow arm of the sea which separates Brehat from the Continent, and eat up all the black ones. Happy ancients! that knew only of poor country mice, and rich city ones;—and unhappy little mice in that while ye were wont at one time to open in acts of hospitality—your bosoms—closely attentive otherwise to your narrow circumstances; and at others—"Bonis rebus agere lætum convivam"—now ye must be content, not with "tenui ervo," but with being yourselves the tender food of one of your own genus!

A scientific commission, consisting of M. Milne Edwards, M. Blanchard, and M. Quatrefages, was appointed in the autumn of 1843 to visit the coast of Sicily. On the 28th March, 1844, they reached Naples. We must refer our readers to vol. i. for information concerning their visit to Palermo and other places, and how they chartered a good boat, with the pretty name of "La Santa Rosalia," and how the Santa Rosalia, at the captain's command of "Yoga," glided rapidly through the waters, and brought them round many a promontory, and over many a bay, stopping the while when the place looked inviting, and going on when it did not. Strange that they always avoided the shores where Caryophylliæ abounded; and yet experience, M. A. de Quatrefages says, taught him that their presence proclaimed the most complete sterility in all other respects.

There are appendices to each volume, in which we have short bibliographical notices of the various authors alluded to in the text, and in some instances more exact information regarding organization and classification than it would be expedient to give in the work itself. We are surprised at the ignorance displayed by our author about our first-class

microscope makers. He speaks of skilful workmen of the present day being able to reach a diameter of 450 with distinctness of vision, and beyond that says the outlines become less clear, and images grow more and more confused. Why we use a Ross $\frac{1}{8}$th, with a B eye-piece, and get as distinct vision as with his $\frac{1}{4}$th, and a magnification of 670. But we must not dwell on this subject any further, or give details that are so very well known to every British microscopist. Once more we advise our readers to peruse these fascinating volumes. Let them read them, and then, in their author's language, if they still preserve any of those illusions, which day by day are vanishing amid the turmoils of life,—"If they regret the dreams that have fled, never to return, these volumes will persuade them to go to the ocean's side, and there, on its sonorous banks, they will assuredly recall some of the golden fancies that shed such a radiance over the hours of their youth: there they will listen to the grand harmonious voices of the winds and waves, as at one moment they seem to murmur gentle melodies, and at another to swell in the thundering crash of their majesty; mark the capricious undulations of the waves as far as the bounds of the horizon, where they merge into the fantastic figures of the clouds, and seem to rise before one's eyes into the liquid sky above! Then let them give themselves up to the sense of infinitude which is stealing over their minds; soon the tears they shed will have lost their bitterness; they will feel, ere long, that there is nothing [appertaining to the earth, and therefore earthly] which can so thoroughly alleviate the sorrows of the heart as the contemplation of nature, and of the sublime spectacle of creation,—which leads, in fact, to God!"

Sea-side Studies at Ilfracombe, Tenby, the Scilly Isles, and Jersey. By George Henry Lewes. With Illustrations. Edinburgh and London: William Blackwood and Sons.

Not long since (*vide* "Nat. Hist. Rev.," October, 1857) we called the attention of our readers to certain useless yet withal pretentious works on various subjects in connexion with Marine Zoology, which the student should carefully avoid, and to the same category we have now to add the "Sea-side Studies" of Mr. Lewes. Inasmuch, too, as his work is better written than any of those to which we have alluded, so also is it to be feared that it will be in a greater degree productive of results injurious to Science. Mr. Lewes is both a ready and agreeable writer, and describes scenes and places in a graphic and amusing manner. In such a passage as the following, wherein he speaks of one of the walks in the neighbourhood of Ilfracombe:—

"Another favourite walk was to Watermouth and Berryn Narbor, over the edges of majestic cliffs, revealing inlet after inlet, each differing in its wealth of colour, each a picture, till we pass into what are called the 'meadows,' really a noble park, through

which runs a stream fringed with wild flowers, and clear as crystal; every twenty or thirty yards the stream falls over an artificial precipice of stones, making a dulcet music. The slopes on each side are richly wooded; and the sequestered silence of this spot adds to its many charms. Who has not felt the deep peace which settles on the soul, when one is lying in the long grass beside a stream, under a summer sun, no sound of traffic, contention, or care, to vex or sadden? Who has not sat upon a gate, less to rest than to enjoy the peaceful idleness of noon, and looked upon the marvellous forms of life active around him, dreaming all the while of pleasant scenes which revisit the memory, or of pleasant hopes rising 'like exhalations of the dawn.' In such a mood we one day rested on a gate under the trees beside this stream; presently, a blind man felt his way also to the gate, and rested there. We spoke to him: he told us, with that sluggish iteration characteristic of the countryman, that this was 'a fine healthy spot, . . . yes! a very healthy spot, . . . a healthy spot.' And he held down his head; alas! it was useless for him to hold it erect, fronting the lovely scene. Saddened by his presence, we soon moved on; and, returning by the cliffs, we came upon another human being, with eyes closed to the beauty around, but closed in sleep, not blindness. A little girl, not more than eight years old, was stretched along the path, her rosy cheek resting on her little arm, which rested on the bare rock. How fast she was! but, as Shakespeare says, 'Weariness will snore upon a flint;' and here was wearied innocence sleeping on a flint, the summer sun pouring down its rays upon her, and also on the milk, which stood in a can by her side. Whether the milk was as much benefited by this rest in the sun on its way to Ilfracombe, the customers thereof must say. All I know is, that the picture was very touching, and I placed a penny in the child's half-closed hand, that she might mind it on awaking. She would think some fairy placed it there."

—or this, which explains the passion of Englishmen for the sea:—

"We are sea-dogs from our birth; it is in our race, bred in the blood. Even the most inland and bucolic youth takes spontaneously to the water, as an element he is born to rule. The winds carry ocean murmurs far into the inland valleys, and awaken the old pirate instincts of the Norsemen. Boys hear them, and although they never saw a ship in their lives, these murmurs make their hearts unquiet; and to run away from home, 'to go to sea,' is the inevitable result. Place a Londoner in a turnip-field, and the chances are, that he will not know it from a field of mangold wurzel. Place him, unfamiliar with pigskin, on a 'fresh horse,' and he will *not* make a majestic figure. But take this same youth, and fling him into a boat: how readily he learns to feather an oar! Nay, even when he is sea-sick—as unhappily even the Briton will sometimes be—he goes through it with a certain careless grace, a manly haughtiness, or, at the lowest, a certain 'official reserve,' not observable in the foreigner. What can be a more abject picture than a Frenchman suffering from sickness, unless it be a German under the same hideous circumstances? Before getting out of harbour he was radiant, arrogant, self-centered; only half an hour has passed, and he is green, cadaverous, dank, prostrate, the manhood seemingly spunged out of him. N. B.—In this respect I am a Frenchman."

—we cannot fail to recognise a writer who can talk in a pleasant and sensible style about matters of every-day occurrence.

In a far different manner does Mr. Lewes treat of subjects of a more purely scientific nature. In these he is evidently not at home. He is, in short, a man of literary habits, and some power as a writer, who has made vigorous attempts to "get up" Zoology by attacking its literature on all sides simultaneously. In the German, especially, he seems to have surpassed himself. Numerous are the allusions to the works of Leydig, Leuckhart, Von Baer, Van Beneden, Müller, and others. But in many instances he seems to have had but a vague conception of the true meaning of these authors. The extent of his learning, however, sinks into insignificance when compared with that of his personal re-

searches. Not that the success obtained is at all times commensurate with the greatness of his preparations. Think of a zoologist encompassing sea and land to behold a large specimen of the thick-horned anemone. Yet, not only does Mr. Lewes do this, but, "stretching (himself) on a sloping bank, leaning into a pool a foot deep," commences to bang away at a chisel, and having succeeded in securing his prey, tells us that "he has cost me twenty minutes' hard labour; but he was worth it."

Not content, however, with employing his hammer and chisel in the above praiseworthy manner, Mr. Lewes attempts, with equal vigour, to solve some of the higher problems of physiology, and from his own account of himself it would appear that no one yet born ever came so well prepared for such a task. He informs us that he "had been led to read extensively respecting the structure and functions of marine animals;" that he "penetrated deeper and deeper into the mysteries of these various organisms;" that "the typical forms took possession of me;" that "this observation was the starting-point of a long series of investigations;" that he had discovered "facts important as well as novel," and made "scores of dissections."

What then may we not expect from one of so great ability, who performed such numbers of experiments after so long a course of preparation? Grievously, however, have we been disappointed. The investigations of Mr. Lewes lead to *nihil.* His ignorance is only surpassed by his egotism. Having asked the question, "Do the Actinia digest at all?" he enters into a tedious and quibbling discussion as to the precise sense in which the word "digestion" is to be employed, and finally arrives at the conclusion that the Actinia do *not* digest, since they have no proper chylaqueous fluid. He infers this from the fact that the fluids contained in their bodies have no action on test-paper; and he confidently affirms that food is discharged from the stomach of these animals without having undergone any disintegration. We need hardly state that both the facts here recorded, and the inferences therefrom, are for the most part incorrect. Elsewhere, however, they have been sufficiently refuted.

The digestive function in the Actinia is not the only question relating to their economy which Mr. Lewes undertakes to decide. He attempts to prove by a series of observations evidently imperfect in themselves, and still less to be depended on in a writer of whose fitness for this kind of scientific investigation the world has been hitherto in ignorance, that the filiferous capsules of the Polypes are destitute of urticating properties. Yet we are assured that "no sooner did I submit the question to that rigorous verification which Science imperiously requires, than it became clear to me that my illustrious predecessors, Wagner, Erdl, Siebold, Quatrefrages, Ehrenberg, Agassiz, and Owen,—men whom the most presumptuous would be slow to contradict—had admitted the point without proof, because it wore so plausible an air—"that, whereas they have only hypothesis on their side, I have the accumulated and overwhelming weight of experimental evidence." And

in concluding this part of his subject he complacently observes that "the foregoing discussion has had a purpose beyond that of rectifying an universal error—the purpose of pointing a lesson in comparative anatomy."

It would be unfair to detain our readers with an account of the numerous errors which Mr. Lewes has fallen into concerning various questions in general zoology. Thus, there is a vain and absurd disquisition about the distinctions between the animal and plant, and a long chapter on Parthenogenesis, in which he throws a cloud of obscure and doubtful learning around a subject not in itself difficult of explanation, so far as the facts which have been already observed warrant us to draw conclusions. It is still more provoking, after having read page after page, to find not a single fact which the most elementary manual would not have furnished quite as well. Quotations, interesting, no doubt, but long familiar to every student who is in the slightest degree familiar with the works of British naturalists, abound: e. g. Johnston's account of the voracity of Actinia, Forbes's numerous descriptions of Luidia, &c. &c. These, however, we hardly object to, since they contrast agreeably with the raw statements of scientific truths which they are intended to illustrate.

Mr. Lewes more than once informs us that certain undescribed forms of marine animals have fallen under his notice. Thus, at page 336 our hopes are raised when we are told of a new species of Tubularia, which he proposes to name *T. parasitica*. No account of this Tubularia is given, nor have we any description of a new genus of Polyzoon which he met with on another occasion. We are left altogether to form our own conceptions of "two entirely new genera of Annelids," about which the author has nothing to tell us beyond the fact of their occurrence. That an author of a work like the present would gladly seize the opportunities afforded him by the description of newly discovered forms of life, to give an air of novelty to a subject on which so much has already been written, seems to us but natural, and we cannot, therefore, help regarding the silence of Mr. Lewes on all such matters as more than suspicious. Notwithstanding our belief in the reality of Mr. Lewes' sea-side travels, there are few parts of his work which might not easily have been written without the necessity of visiting the sea at all. We ourselves, when in search of Plumatellæ, are accustomed to find these animals in ponds or rivers. Not so Mr. Lewes, who, disdaining this common mode of procedure, discovers a Plumatella (?) between tide-marks. Not a word of description is added concerning this new and interesting marine form!

It is to be feared that many misguided persons, charmed by the lofty assertions and agreeable style of Mr. Lewes, may accept as original the numerous plagiarisms with which his book is stored. But we would caution all such to beware before they surrender their judgment to an author who marvels at the sight of live cowries, and cries out, "By heavens!" when he sees a common Comatula.

The illustrations are, with one or two exceptions, borrowed, and executed in a very inferior style.

Here and there we meet with a pleasant passage, on such subjects as the ill success of amateurs at the sea-side (which no one, from personal experience, can describe so well as Mr. Lewes), and the difficulties with which fishermen are induced to collect marine animals. Indeed, the perusal of the entire work has led us to regret that so good a writer as Mr. Lewes should have chosen a subject which he is totally incompetent to do justice to.

Actinologia Britannica: a History of the British Sea-Anemones and Madrepores, with coloured Figures of all the Species. By Philip Henry Gosse, F. R. S. London: J. Van Voorst. No. I., March 1, 1858. Price 1*s.* 6*d.* pp. 32, and one coloured Plate.

Part I. of a long desired work is at last before us, and we hasten to give a sketch of its contents, and to inform our readers of their nature and of their merits. The first thing we find on opening the pages is a handsomely executed lithograph; this we will not now allude to, but pass on to the letter-press. First, we have a general description of a Sea-Anemone, and an explanation of the terms used in describing one. Among the terms used there are none very original; indeed, we would have been better pleased if a few good technical words had been adopted as descriptive of the anatomy of these animals; and if the homology of the various parts of the cavity had been alluded to and illustrated by a few woodcuts, it would have been much more instructive. Next we have the characters of the sub-order Actinaria, of which this monograph is to treat, which sub-order is placed under Actinoida, an order of the class Zoophyta. We do not like this word, and we are sorry to find Mr. Gosse using it; we think the sooner the word is forgotten, the better: like the Radiata of Cuvier, it brings up to our mind's eye a most heterogeneous assemblage of animals belonging to different types of creation; and since modern research has placed all these, or at least nearly all of these, in their proper places, we see no good reason for perpetuating a name that but leads to false impressions. Under the tribe of Astræacea we find the first British family—that of Sagartiadæ—in which the tentacles are simple, arranged in uninterrupted circles, and the body perforated for the emission of armed retractile cords. The typical genus of this family is most undoubtedly Sagartia; the one which Mr. Gosse places first in the list, Actinolobia (*Blainv.*), being by no means a characteristic one, the tentacles not being arranged in uninterrupted circles, nor the body being furnished with acetabulæ. We only possess a single species of the genus Actinolobia, the well-known Dianthus; the presence of but a single gonidial groove, and the margin of the column, forming a thickened parapet, are among the chief characteristics of this genus. We have very full details given us about the Plumose Anemone, its habits and habitats. Mr. Gosse says he never had an opportunity of

seeing this Anemone increase by the discharge of ova or young, but only by a process of spontaneous division; that the discharge of young does sometime happen, we can, however, testify, once having had in our possession a countless brood, born in this manner, the production of a venerable Dianthus. We do not know that this increase by "spontaneous division" has been properly investigated: Mr. Gosse but slightly alludes to it, not entering into any special details. We have a theory on the subject—a theory it must remain till we can find proofs, and we give it *pro tanto.* In the intersepta (we use Mr. Gosse's terms), we have the ovaries attached to the free edges of the secondary and tertiary septa, and running down into the base, enveloped in a thin, semi-transparent membrane. Perhaps the normal way for the ova or young Anemones, on becoming detached from the ovaria, to escape from the chambers of the parent, would be through the stomach, and thence into the throat, from whence the tide would wash them away; but if, instead, they got entangled in the lower portion of the cavity of the parent, and so into the extreme border of that part which is more properly called the disc, here they would act as foreign bodies, and the natural impulse would be to get rid of them by rupturing this thin border from the remaining portion. This being done, and the ova still growing, these ruptured bits would soon become smooth, then spherical or oval in outline, and at last the tiny tentaculæ of the young Actinia would make their appearance. But we leave these guesses to notice the first species in the next genus, Sagartia, which is the last one this Part contains, i. e. Bellis, the well-known "Daisy Anemone." We were somewhat impatient to see whether it would be made a new genus or not, but all our author says is:—"But for the needless multiplication of genera, I should be tempted to separate it from the other Sagartia." Well, perhaps so, and yet who that is accustomed to watch it with a "philosophic eye" but would be tempted to do so? Why, if it was a Mollusc, and J. E. Gray to "come at it," especially if he had the advantage of studying it from life, he would never rest satisfied till he had made it a genus—perhaps he would make it a sub-genus. Part I. ends without finishing the history of this Actinia, and with a notice of the plate we must conclude too. Plate 1 is a coloured lithograph, containing figures of *Actinolobia dianthus; Sagartia bellis, troglodytes, rosea* (three figs.), *venusta,* and *sphyrodeta* (three figs.). It is a very difficult thing to print in colours, with effect, such semi-transparent things as Sea-Anemones, and while we could not conscientiously say that any of these figures are perfection, yet we do say that they are the best of the kind executed in Britain (especially that of *Sagartia venusta* and *S. rosea*), we have yet seen, and are a very great boon to collectors. In fine, this work promises to vie in splendour with any of the British monographs of Van Voorst; and we feel confident that, from the extreme interest and popularity of the subject, and from the esteem in which Mr. Gosse, as a writer on these subjects, is held, the success of this monograph will be complete; and it is a perfect novelty to get so much print and illustration for the sum of eighteenpence.

First Lessons in Botany and Vegetable Physiology. Illustrated by over 360 Wood Engravings from Original Drawings by Isaac Sprague. To which is added a Copious Glossary, or Dictionary of Botanical Terms, by Asa Gray Fisher, Professor of Natural History in Harvard University. 1858.

We have carefully looked over this volume, written in simple language, illustrated by extremely well executed woodcuts, and think it will form a very useful addition to our list of school manuals. We would have no hesitation in putting it into the hands of any student in Botany. We think it would make a very useful text-book for Professors of Botany, or for the Lecturers in our various schools. It comprises a very full account of the structure, organs, growth, and reproduction of plants; and we quite agree with the author that these subjects ought to be as generally understood by all educated people as the elements of Natural Philosophy or Astronomy are, and they are quite as easy to be learned. We have reason to believe that of late years Botany has become a very general study; but until the present volume we have met with no work which gave the same amount of useful knowledge for so small a sum of money. The illustrations are, with one or two exceptions, all original, and were drawn from Nature by Mr. Sprague, the well-known botanical artist; they have been very freely introduced into this volume.

From one statement of Professor Asa Gray's we would venture to dissent, viz., that there is a positive harm in introducing questions at the end of either the lessons or chapters. We hold that if the questions be of a proper character, they are a most important element in a work like the present, and they should be of such a nature as not to afford facilities either to teach or learn by rote; on the contrary, they should be so framed as to be perfectly useless to a teacher; while they should set the mind of the student himself a-thinking—questions of which the answers, although, of course, to be inferred from the chapters to which they are appended, yet should not be arrived at without a due amount of deliberation upon the subject contained in the chapter.

We understand that Messrs. Trübner and Co., London, are the British agents for these useful Lessons.

Messrs. Trubner and Co.'s Catalogue of American Works on Natural History.

Through the kindness of Messrs. Trübner and Co., we are enabled to present our readers with a copy of this valuable Catalogue of American Works on the Natural Sciences published during the last forty years. This Catalogue evinces a great deal of patient research, and is, we think, one of the most useful things of the sort yet published. We would

suggest that it should be carefully preserved and bound up as part of the "Review" at the close of this year.

While our own publishers (Messrs. Williams and Norgate) are ever foremost in introducing to the notice of British naturalists the works of our Continental brethren, Messrs. Trübner and Co. are not the less active in keeping us acquainted with the productions of our Transatlantic friends.

PRODROMUS DESCRIPTIONIS ANIMALIUM EVERTEBRATORUM, QUÆ IN EXPEDITIONE AD OCEANUM PACIFICUM SEPTENTRIONALEM A REPUBLICA FEDERATA MISSA. Cadwaladaro Ringgold et Johanne Rogers Ducibus; observavit et descripsit W. Stimpson. Pars II.

WITH the first Part of Mr. Stimpson's "Prodromus" our readers are already familiar (*vide* "Natural History Review," vol. x. p. 79). The present Part, containing eight pages, is entirely devoted to the *Turbellaria nemertina*, of which the author describes ten new genera, including fourteen species. In accordance with the views of other naturalists, the species included under the old genus Meckelia are referred by the author to four genera, namely, Lineus, Cerebratulus, Serpentaria, and Meckelia proper. We trust ere long to have the pleasure of noticing the third Part of our author's useful descriptions.

ON THE NEW RED SANDSTONE FORMATION OF PENNSYLVANIA.

DESCRIPTION OF A NEW SUB-GENUS OF NAÏADES.

DESCRIPTION OF A NEW SPECIES OF TRIQUETA.

DESCRIPTION OF NEW FRESH-WATER SHELLS FROM CALIFORNIA.

DESCRIPTION OF TWENTY-FIVE NEW SPECIES OF EXOTIC UNIONES.

By Isaac Lea, LL. D., &c. &c., Philadelphia.

THE above list includes the names of a series of papers read by the author before the Academy of Natural Sciences of Philadelphia, and extracted from its Proceedings. An abstract of the first paper, with a full Latin description of each of the new forms mentioned in the others, is continued in the little eight-page tract before us. In the Pennsylvanian New Red Sandstone Mr. Lea has found the tooth of a Saurian reptile, which he proposes to name *Centemodon sulcatus*. In the same formation he has detected two new species of Posidoniæ, footmarks of a supposed species of Chelichnus, impressions of coniferous plants, of which one of the cones was nearly six inches in length, and a Ganoid scale, which bears some resemblance to those of the *Pygopteris mandibularis* of Agassiz. The descriptions of the new species in the remaining papers speak for themselves, especially those of the twenty-five new Exotic Unios, the account of which will be of most interest to those who are familiar with the elaborate monograph of the distinguished author.

Correspondence.

[We publish the following letter without comment, reserving our remarks on the whole subject for a future occasion.—Eds. N. H. R.]

TO THE EDITORS OF THE NATURAL HISTORY REVIEW AND QUARTERLY JOURNAL OF SCIENCE.

Gentlemen,—The last number of the Review contained an article on Mr. Gosse's "Omphalos" which excited some surprise in my mind. It is true the reviewer does not in the least accept Mr. Gosse's conclusions, but he says "the logic of the book is unanswerable," and compares it to Berkeley's "Dialogues," and Fontenelle's "Pluralite des Mondes." As Mr. Gosse's book treats of a subject of which I pretend to some knowledge, and as my estimate of that production is very different indeed from that given in the article referred to, perhaps you will allow me a little space in your next Number to give the reasons for my opinion.

I make no pretensions to skill in the art of logic, but the mere reasoning of Mr. Gosse's book seems to me of the most flimsy character, based on what I think logicians would call a "petitio principii," and involving, I am sure, a "non-sequitur" of a most prodigious and palpable description.

What is the meaning, in the first place, of his two so-called laws?—

1. "All organic nature moves in a circle."
2. "Creation is a violent eruption into a circle."

And how does he *demonstrate* them? It appears to me, the demonstration consists in simply drawing a circle, and arranging the different stages of the life of an individual upon it.

Looked at as a mere diagrammatic form of expression, it is defective, since it suggests the idea of individuals reproducing, not their like, but themselves. To call the succession of generations, and the consequent multiplication of individuals, *a circle*, is a mere vicious metaphor, unless, indeed, we could suppose that a man might beget his own father or grandfather, and that the present generation were alike the descendants and progenitors of the past.

Then, what possible benefit can be gained by styling the miracle of direct creation a "bursting into a circle."

There is nothing in Oken's Elements more clumsy and far-fetched in expression, and more confused in idea, than this phrase, for there is, in reality, no circle; and if there were, the arbitrary commencement of a continuous curved line could not be a "bursting into" the figure, which did not exist till the line was completed.

Reasoning based on a mere metaphorical phraseology, and that of an entirely vicious character, cannot lead to any sound conclusion.

The one idea on which Mr. Gosse's book is founded is an obvious one, which has been alluded to by others, and must have occurred to most men who thought on the subject at all, but never appeared to any one before worth the trouble of elaboration.

The idea is simply this,—a newly created organic being, or pair of beings, must, so far as we can see, have been essentially the same as all its or their descendants, and, therefore, each must have had all the marks of being itself the descendant of a parent; and at whatever stage of life each was brought into existence, it must have been just like all its descendants in the same stage, and must, therefore, have appeared to have already passed through the stages of life previous to that one. Mr. Gosse, accordingly, takes upon himself to imagine that he and another person actually meet with a number of newly created animals and plants, and after detailing to this other person all the evidence of growth and previous existence, and descent from parents, to be found in these individuals, comes down upon him with the assurance in each case that the evidence is entirely false, for that, from private information of his own (he does not say how obtained, or obtainable), he knows that the individual in question has been only that instant created.

This ridiculous statement is repeated over and over again for twenty or thirty species of plants and animals, ending with man and his navel. This repetition reminded me irresistibly of a comic song I recollect to have heard at Cambridge supper-parties some five and twenty years ago, the joke of which (not a very brilliant one) consisted in detailing all kinds of anachronisms and absurdities, such as Wat Tyler stabbing Julius Cæsar, &c., and then very unnecessarily assuring us the thing was impossible. Guy Fawkes, I think, came over Waterloo Bridge—

"To perpetrate his guilt, sir,
That is to say he would have done, but a little thing prevented him,
He couldn't come that way, you know, for the Bridge it wasn't built, sir."

If Mr. Gosse's book were really worthy of serious and detailed refutation, we might pause, I think, here for a moment to consider whether it be not a piece of unwarrantable presumption, and something very nearly approaching to that impious irruption of certain persons "where angels fear to tread," for any one to treat the awe-inspiring mystery of direct creation with the flippant familiarity which Mr. Gosse ventures upon. To a man of a really serious and religious tone of mind, this treatment is far more repulsive than that even of the author of the "Vestiges of Creation," and the Lamarckian School. Both classes of reasons appeal to our ignorance rather than our knowledge, and take upon themselves to make positive assertions upon things about which no man *knows*, perhaps no man ever *shall* or *can* know, anything whatever; but the *soi-disant* religious school to which Mr. Gosse belongs has the additional bad taste to speak as if they, forsooth, were on the most intimate terms with the Creator of all things, and were enabled by private favour to speak confidently and authoritatively on all those secrets and mysteries on which a reverent man only ponders silently in his most solemn and meditative moods.

To return, however, to the argument: Mr. Gosse having, by begging the question, established the inconclusiveness of the evidence derived from the structure of all these freshly created species that he so conveniently and so very improbably happens to stumble upon, makes then a most tremendous jump, and after a vigorous pirouette in the air, alights upon the ground that the whole earth was created after the same fashion as these hypothetical individuals, bearing, that is, within itself all the marks of having passed through many previous stages of existence, those marks being created in it at the very moment of its coming into existence. He does not go on to complete what he calls his circle, and say that the earth bears internal evidence of descent from a pre-existent parent, and is likely to produce young worlds, an omission which, for the sake of his own argument (to say nothing of the amusement of his readers), is to be regretted, inasmuch as it makes his construction rather top-sided, and renders a great part of his previous data unnecessary. But how does he make this jump, or rather, how does he try to cover and conceal this great gap of a "non-sequitur" in the chain of his reasoning? Simply, by the old device of vapouring about with a—"Who will dare to deny it?" "Who will say that the suggestion, *that the strata of the surface of the earth, with their fossil Floras and Faunas, may possibly belong to a prochronic development of the mighty plan of the life-history of this world;* who will dare to say that such a suggestion is a self-evident absurdity?"

It may be over-bold of me, but I certainly do venture to deny that the earth is an organic being, or is at all analogous to an organic being. Instead of blustering and daring any one to deny it, it was incumbent on Mr. Gosse to *prove*, or to render *probable*, or at least to give some reason for *supposing it likely*, that the earth could not have been created without bearing marks in its internal structure such as would have been produced by its having passed through several stages of existence.

We cannot conceive the existence of an organic being that has not organic structure, capable of performing the organic functions that are necessary for the continuance of its existence, and having performed those necessary for its past existence, and for elaboration of those parts of its structure which are the results of those functions. For a newly created organic being to be like its descendants, or capable of having any, it must itself, *apparently*, have all these characters. Is there any such necessity in the case of an inorganic world? "Will any one dare to say" (to adopt Mr. Gosse's phraseology) "that the world could not have been created without bearing such internal evidence of pre-existence at the moment of creation?" To render his argument worth the paper it was written on, Mr. Gosse must maintain this position, and support it with some show, at least, of reasoning, and not with a mere daring of anybody to deny it.

Let us throw Mr. Gosse's reasoning into a syllogistic form as the best method of testing its logic:—

First syllogism:—

A. All organic beings bear in their structure evidences of previous stages of existence, or of a pre-existent parent.

B. The earth bears, in its structure, evidences of previous stages of existence.

C. Therefore the earth is an organic being.

Second syllogism :—

A. Every individual of an organic species bears within itself evidences of previous stages of existence, or of a pre-existent parent.

B. But in the first created individual of a species this evidence must have been false.

C. Therefore the evidence of previous stages of existence which the earth bears within itself are false. "Non-sequitur," unless the conclusion of the first syllogism be accepted as true, and unless it can also be shown that the earth is the first created individual of a species.

So much for Mr. Gosse's logic. He equally fails in attempting to get rid of the force of the objection, that if the fossils and other evidence of previous stages of existence were *created* in the earth, it must have been with the *intention* of deception. He asks, with an air of triumph: "Were the concentric timber-rings of a created tree formed merely to deceive? Were the growth lines of a created shell formed merely to deceive? Was the navel of a created man intended to deceive him into the belief that he had a parent?" To which the answer is—"Certainly not, and they never did deceive any one." The evidence in each and all of Mr. Gosse's cases is perfectly true, and always was true, and will be true, for every individual except for such hypothetical ones as Mr. Gosse imagines himself to find. Will Mr. Gosse venture to affirm that Adam himself was led into any delusion on these matters, or that any one of his descendants has ever been deceived into drawing false conclusions from the examination of a newly created individual of a species, or even that any man ever will be thus deceived? But if the evidence contained in the earth be false, hundreds and thousands of men must inevitably be deceived, and will continue to be so (Mr. Gosse's "Omphalos" notwithstanding), and deceived, too, by false appearances artfully contrived and adjusted to the very faculties implanted in man by the Deceiver. And the deceptive structure does not perish with the first individual, but remains false for ever, as long as the earth endures, and becomes eventually so blended with true evidence derived from exactly similar structure produced by subsequent operations, as to vitiate even that, and thus not only bear false witness itself, but corrupt and render untrustworthy true and faithful witness. All these, and many more incredible and impious consequences, would flow directly from Mr. Gosse's conclusion.

What, may I ask, becomes of Mr. Gosse's Berkleian acuteness, if he overlooked these consequences? or what are we to think of his honesty if he suppressed them?

But, indeed, it is quite hopeless to reason with Mr. Gosse. He winds

up his book by simply declaring his firm and implicit belief in his own literal interpretation of the words of the first chapter of Genesis, and avowing that no amount or kind of evidence or argument can shake this belief.

Appeal to Astronomy, and tell him of the hundreds and thousands of years required for the passage of light from the more distant bodies of the universe to our eyes, so that the fact that we see them proves that they existed so long ago. "Not at all," he replies; "their existence was prochronic, the light was created on its passage, at the same time as the bodies themselves were created. It was created at the very eyes of Adam, so that he saw them the first night of his and their existence."

He would even maintain that, with respect to the most distant of them, we ourselves may, perhaps, perceive them by "prochronic" and not real light, by light created in mid space, for the sole purpose of informing us of their existence.

He speaks of the possibility of the earth having been created in the year 1857 of our present era, with ruined and half-built houses, half finished pictures, half-written books, the ashes of some that have been burnt, newspapers fresh from the press, giving accounts of the "prochronic" occurrence of 1856, old men, and young children just born, some still in the womb, and graveyards filled with the mouldering bones of their "prochronic" ancestors. He would convert the universe into a cave of glamour, and degrade the Creator to an Arch-Magician. Admit his conclusions as even possible, and we have no longer any certainty of the existence of any moment but the present. The last number of your Review, Gentlemen, and even "Omphalos" itself may never really have been written and printed;—the copies now on my table may be only evidence of their "prochronic" existence; and the next step will be that we must even disbelieve the present, and allow the possibility of our even now being only in a "prochronic" state, and that nothing of us really exists, but is only to come into existence in Anno Domini x, y, z.

Apologising for trespassing at so much length upon your pages,

I am, Gentlemen,

Your obedient servant,

J. Beete Jukes, A. M., F. R. S.

Zoology: being a Systematic Account of the General Structure, Habits, Instincts, and Uses of the Principal Families of the Animal Kingdom; as well as of the Chief Forms of Fossil Remains. By W. B. Carpenter, M.D., F.R.S., &c. A New Edition, thoroughly revised, by W. S. Dallas, F.L.S., &c. In two volumes. Vol. II.

The present edition of Dr. Carpenter's Zoology consists, like its predecessor, of two volumes. In the first are described the Mammals, Birds, Reptiles, and Amphibians. The second volume concludes the Vertebrata with an account of the class of Fishes, but is chiefly occupied with the consideration of the several classes which constitute the four remaining sub-kingdoms, known collectively under the name of Invertebrata.

In his description of the Fishes Mr. Dallas departs from the Cuvierian arrangement generally followed, and adopts as his classification a modification of the subdivision of this class proposed by the late Professor Muller. The entire class is regarded as consisting of five orders, of unequal extent, viz.:—1. Selachii; 2. Ganoidei; 3. Teleostei; 4. Cyclostomi; 5. Leptocardii. The highest rank is assigned to the Selachii. The greater number of recent fishes are included under the Teleostei. The order Leptocardii includes but a single species,—the *Amphioxus lanceolatus.* The systems of Cuvier and Agassiz are, however, explained; and, upon the whole, the particular account of the more important families, though deficient in some respects, must be regarded as not unsatisfactory.

The extensive sub-kingdom Articulata is divided into two primary groups, the first of which includes the classes Insecta, Arachnida, Myriapoda, and Crustacea; while the second comprises the Annelida, Entozoa, and Rotifera. It would have been more correct to have restricted the application of the word Articulata to the first of these, the second being designated by the name of Annuloida. The entire sub-kingdom might be known by the term Annulosa. And we are also of opinion that, in accordance with the opinions so ably put forward by Professor Huxley, the Echinodermata should be placed in the division Annuloida. But of this, more anon. The subdivision of the Annulosa into the two natural and extensive groups above mentioned seems to us an appropriate introduction to the full consideration of so important a department of the animal kingdom. More than one-fifth of the volume is devoted to the insects alone. This vast class is divided into twelve orders, of which nine are placed in one sub-class, Metabola, and three in another, Ametabola. The meaning of the more important terms taken from the cibarian system is at the same time explained. But the number of orders (twelve) seems to us to be about twice too many. The subdivision of this class has been carried by modern naturalists to an injudicious extent. And this will ever be the case so long as entomologists direct their attention too exclusively to searching for trifling and unimportant differences, while at the same time leading and significant peculiarities of structure are unheeded. The Metabola are further arranged under two

divisions, the first of which includes the eight orders of winged insects: the last contains but one order, Aphaniptera. This last division is certainly a needless one, for it would have been more correct to have referred the Aphaniptera to the Diptera. Mr. Dallas, however, further on, states that this is the opinion of many entomologists. The Mallophaga are here regarded as a distinct order.

The account of the class Myriapoda occupies little more than five pages. Nothing is here said concerning the late Mr. George Newport's valuable researches concerning the development of these animals; and we cannot but consider this omission as a serious deficiency. The Arachnida are described at somewhat greater length. The Crustacea are subdivided into six sub-classes—namely, Podophthalma, Edriophthalma, Xiphosura, Entomostraca, Cirrhopoda, and Araneiformia. The proper place of the last-mentioned group (= Pychnogonidæ) would seem to be among the Arachnida. Mr. Dallas, indeed, though placing them among the Crustacea, alludes to the difficulty of assigning their true position. The sub-classes Podophthalma and Edriophthalma are more generally regarded in the light of primary divisions of one larger sub-class, Malacostraca; and until additional light can be thrown on the true affinities of the Trilobites, it would be, perhaps, the best course to constitute a separate sub-class for this remarkable group,—a rank, moreover, of which they seem to be not unworthy.

An abstract of Milne Edwards' conclusions in regard to the geographical distribution of the Crustacea concludes the account of the Articulata proper. This, however, is simply copied from the first edition. Here also, we think, might with advantage have been introduced a general comparison of the four articulate classes, giving a concise summary of the more important distinctions which separate them from one another, explaining also their mutual relations and the homologies of their various parts. This, we regret to say, the editor has not given; thereby neglecting to furnish the student of this branch of zoology with a help which no educational treatise has hitherto supplied.

The several classes of the division Annuloida are described in a brief and unsatisfactory manner; very many interesting points in connexion with their history being left untouched. Almost nothing is stated with reference to the development of the Rotifera, nor are the curious affinities which this class bears to allied groups properly discussed or elucidated; and yet there are few questions in zoology capable of being made so interesting and instructive to the student.

We have been much disappointed with that portion of the present volume which professes to treat of the sub-kingdom Mollusca. The editor seems to have availed himself but little of the numerous additions which have recently been made to this branch of zoological literature. The valuable observations contained in Professor Huxley's papers on the Morphology of the Cephalous Molluscs and on the Structure of the Tunicata, published, we need hardly inform our readers, some years since, in the "Philosophical Transactions of the Royal Society," are not even alluded to by Mr. Dallas. Not a word is said concerning the affinities

of the Brachiopoda, the account of which important class is compressed into less than four pages. Their peculiar muscular system is not described, nor are the mere names of all the families given. The Tunicata likewise are very imperfectly described; the division of this class into the two orders, Salpa and Ascidia, being, moreover, decidedly erroneous. Many animals of this class, presenting interesting peculiarities of structure, are not even mentioned by name. We allude more especially to such genera as Doliolum and Appendicularia. To such of our readers as have not already made themselves acquainted with it, we would recommend the perusal of an excellent paper on the latter genus by Mr. Huxley, in the third volume of the "Microscopical Journal." In accordance with opinions now universally adopted, the Polyzoa are placed in the molluscous sub-kingdom. But the student will find few of the results of recent researches into the structure and development of these forms in the meagre and incomplete survey afforded of the class by Mr. Dallas. His classification of the Polyzoa is wrong; his account of their development still worse. The peculiar bodies termed 'statoblasts' are not spoken of, nor are we told that the Polyzoa possess a nervous system. These omissions are the more culpable, since the admirable monograph of Professor Allman, published by the Ray Society, contains a concise, though complete, account of the present state of our knowledge of this most interesting class.

Dismissing the Mollusca, we now turn to the sub-kingdom Radiata. We have already, on more than one occasion, given our verdict in favour of those naturalists who are of opinion that the name of this group should be abolished. The class Echinodermata must for the future be referred to the division Annuloida, as has been ably shown by Mr. Huxley; and the remaining Radiata will then form a distinct sub-kingdom, Cœlenterata. The dread of interfering too much with a work of which he was only the editor may, perhaps, have prevented Mr. Dallas from adopting an arrangement not hitherto followed in any elementary manual. He divides the Radiata into three classes—Echinodermata, Polypifera, and Hydrozoa. The subdivision of the first of these classes here given is most incorrect. Many years have now elapsed since Professor E. Forbes clearly showed that the Ophiuridæ constituted a distinct and well-marked order; and most modern naturalists have viewed them in the same light: yet Mr. Dallas continues to unite them, together with the Asteriadæ, into one order, Steileridæ. Again, when we consider that the present treatise proposes to describe the chief forms of fossil remains, no excuse can be given for omitting all mention of the two remarkable extinct orders, Cystidea and Blastoidea.

In commencing our brief observations concerning the Cœlenterata, we are first met by the question, "Why is the division of this group into the two old classes, Zoophytes and Acalephæ, incorrect?" The answer is, simply, "Because it is founded on an anatomical error." The Cœlenterata are divided into two natural groups—1st, Hydrozoa; and 2nd, Actinozoa. In the Hydrozoa the walls of the alimentary canal and of the general cavity are almost identical, while the reproductive organs

are placed on the outside of the body. In the Actinozoa the stomach wall is separated by an intervening space from the outer integument. This intervening space is subdivided by numerous partitions, and in the chambers so formed the reproductive organs are lodged. Now, some of the Zoophytes, for example, the Hydra, belong to the Hydrozoa; while others, as the Actinia, belong to the Actinozoa. These two genera are, in fact, the types of the two respective groups in question. Again, certain Acalephæ, as the Pelagia, or the Physalia, belong to the Hydrozoa; while others, as the Cydippe, are clearly referrible to the Actinozoa. Consequently, the two classes, Zoophyta and Acalephæ, are unworthy of adoption, being unnatural. Nor does Mr. Dallas employ them, but substitutes two classes, Hydrozoa and Polypifera. Yet he, at the same time, falls into the error which we have just noticed, for he refers the Ctenophora to the Hydrozoa, though he adds that, in his own opinion, they ought to be placed in a class by themselves. Yet no fact in comparative anatomy can be considered more surely established than is the structural correspondence which has been proved to exist between the Actinia and Beroida.

The Polypifera (Actinozoa) are briefly and badly described. No example is given of a non-adherent Actinoid, such as Iluanthos, &c. Capnea, Zoanthus, and other important genera, are passed by without any mention, and the student who expects to find the several parts of a common coral polype enumerated and explained will surely meet with disappointment. We are told, most erroneously, that no communication exists between the chambers and stomach in an Actinia; and, further on, that nothing analogous to reproduction by buds occurs among these animals. A mistake which had crept, probably by inadvertence, into the former edition of this work, is allowed to remain uncorrected in the present. It is stated that "Hughes, in his 'Natural History of Barbadoes' (a work published before the distinctions between the animal and vegetable kingdoms were properly understood), denominates it (the Actinia) *a sensitive plant having animal properties.*" Now the truth is, that Hughes makes no such assertion, and any one who will read attentively, as we have done, the account referred to, will be fully convinced that the true animal nature of the sea-anemone had been rightly divined by this honest and intelligent observer.

The Hydrozoa, if we except a long account of the common freshwater polype, are hastily and insufficiently noticed. No examples of a solitary Tubularian polyp, e. g. Corymorpha, is given, and the entire group of Diphyidæ is altogether passed over. The Siphonophora are dismissed in a page and a half. Yet, even within this short space, an error, which could scarcely have been anticipated, is committed. We are told that the Siphonophora present two very distinct types of structure, and may be, accordingly, divided into two groups, the Physograda and the Chondrograda. It is certainly true that the Siphonophora may be divided into two very distinct groups, but the Diphya is the type of one of them, and the Physsophora of the other. To this last group (Physsophoridæ), both the Physalia (Physograda) and the Velella (Chon-

drograda) belong; the cartilaginous disc of the latter being nothing more than a peculiar modification of the float of the Physsophora. Other errors, similar to this, might readily be pointed out. The simple and concise terminology introduced by Professor Allman for the better description of the Hydrozoa is not explained, nor are any of these even made use of. The reproduction of the Hydrozoa, and, we may also add, their anatomy, is very briefly alluded to, and such terms as "individual," "compound animal," &c., are carelessly and incorrectly applied.

The lower we descend in the scale of organization, and approach the confines of the animal kingdom, the shorter and more inaccurate do we find the descriptions of Mr. Dallas. The sub-kingdom, Protozoa, is hurried over in a manner altogether inexcusable. The Polycistina, Thalassicollidæ, Gregarinæ, and Pserospermia, are taken no notice of, even by name only. The class Rhizopoda is dismissed with scarcely any statement of their true structure, and the so-called encysting process among the Infusoria, as described by Stein and other observers, is hastily noticed in about three lines. The distinguishing characters by which the true animal Infusoria may (so far as the present state of our knowledge permits) be ascertained, are very imperfectly stated.

Many of the figures are very indifferent, some are positively inaccurate, and few, if any, new ones appear to have been introduced.

When our attention was first directed to the forthcoming appearance of the present work, we hailed its advent with joy, trusting that the day had at length arrived when the student might obtain that of which he has so long felt the need,—a good elementary work on zoology. We need hardly say how much we have been disappointed. The lower forms of animal life—of which no account that the advanced student could consult with safety and confidence has yet been published—are here described in a manner so incomplete and unsatisfactory as altogether to preclude this work from being introduced where such a treatise seemed most needed, namely, into our universities. Yet we trust that, ere long, such a work, written in a style befitting alike the important purpose which it is destined to serve, and the advanced state of science which it purposes to teach, will be undertaken by some of those who have not merely the ability and discrimination necessary for the performance of such a task, but who are, at the same time, conscious of the high responsibility and careful exercise of judgment which it must involve. We wait then in hope for its appearance.

The Ground beneath us, its Geological Phases and Changes: being Three Lectures on the Geology of Clapham, &c. &c. By Joseph Prestwich, F. R. S., &c. London: Van Voorst. 1857.

A Geological Enquiry respecting the Water-bearing Strata of the Country around London, &c. &c. By Joseph Prestwich, F. R. S., &c. London: Van Voorst. 1851.

The unpretending and well-written essay on the geology of the district around London, which we have placed at the head of this article, would of itself be sufficient to justify the position that Mr. Prestwich deservedly holds among English geologists. Although it only professes to treat of the geology of the neighbourhood of Clapham, yet, from the similarity of the geological phenomena around London, it is equally applicable to many districts in the vicinity of the metropolis. As Mr. Prestwich himself says, in his Preface:—

"The subject is one of more than local interest, for Clapham stands upon ground which forms part of the London Tertiary district, and consequently the account here given of the Drift and of the Tertiary strata is equally applicable to the ground beneath London and to some distance around; and no separate work having yet been published of the Geology of London and its neighbourhood, and this account, though general, touching upon most of the leading points, besides including a short discussion of some views not yet brought forward elsewhere, especially those respecting the Drift, I trust that this sketch may also be of some use as a guide to those even who have made Geology more particularly their study, and that it may supply for the present the want of a more special treatise."

In the first of the three Lectures Mr. Prestwich discusses the drift gravel of Middlesex, and gives some very interesting facts respecting its physical character and distribution. It forms, as is well known, the matrix of all the surface pumps and wells of London, and gives a supply of water, which, though now somewhat impure, is, on the whole, of great value to many portions of the metropolis. We ourselves know of some pure wells of spring water in dark cellars of murky houses in back streets, which, to one not so fastidious as a teetotaller, would seem sweet and fresh; but, in most places, where this water is either pumped or comes to the surface, it is contaminated by the sewage of the over-populated streets.

We cannot do more than advert to the very interesting discussion as to the origin of the subangular and rounded chalk flints, and other rarer pebbles found in the London Drift, and pass on to the organic remains which have been found in it:—

"Amongst the Quadrupeds whose remains have been recognised, we have an Elephant, a two-horned Rhinoceros, a large animal of the feline tribe related either to the Lion or the Tiger, a large Hippopotamus, a great Bear, a formidable Hyæna, the Red-deer, the Rein-deer, the Wolf, an Ox, and a Horse. This must strike you as a very singular group; for, associated with a few animals still common in these latitudes, we here have, on one side, animals of a class now living only in the hot and torrid zones, and, on the other, animals now confined to the cold and frigid zones. To determine their relations and to draw correct inferences with respect to the climatal conditions prevailing during the period at which they lived, are questions requiring extreme caution."

In discussing the question of climate, arising from the discovery of such an assemblage of post-tertiary fossils, Mr. Prestwich quotes a fact which may not be familiar to those of our readers who are not geologists:—

"A remarkable confirmation of this view has since been afforded by the researches of a Russian naturalist, Dr. Brandt, who also observes, speaking of the *Mammoth* and the *Rhinoceros* (another animal that might seem to indicate a tropical climate), the remains of which are found associated in the drift of Siberia, that 'the thick covering of hair on both animals shows that a tropical climate was not necessary for their existence.' He then proceeds to state that he has been so fortunate as to extract from the cavities of the molar tooth of the Rhinoceros, preserved in the frozen ground of Siberia, a small quantity of its half-chewed food, among which 'fragments of pine-leaves and minute portions of wood with a coniferous structure were still recognisable,' showing therefore that the animal could find food in the pine forests of those cold regions, and no doubt lived there."

The London Clay, which forms the subject of the second and third Lectures, is better known than the London Drift; and we must, therefore, refer our readers to the book itself for further information respecting it.

The author has given a summary of his theoretical views in the last ten pages, commencing page 71. It is too long to quote, but possesses the highest interest, proceeding as it does from a geologist who has done more, by his personal exertions, to throw light on the English Tertiaries, than any other living geologist.

Mr. Prestwich's other and earlier work is well known to every hydraulic engineer, as a manual of the theory of wells and Artesian springs in the London Clay. We refer to it now, in order to render the author a justice which has been denied him by some who were more anxious to find a flaw than to render homage to the sagacious predictions of science.

The work is, in brief, a detailed prediction of the probable results of sinking Artesian borings in London into the Lower Greensand beds below the chalk. Mr. Prestwich's estimate is as follows, *vide* page 142:—

	Feet.
Tertiaries, ...	200
Chalk, ...	650
Upper Greensand, ...	40
Gault, ...	150
	1040

The experiment recommended by Mr. Prestwich has actually been tried by the Hampstead Water Works Company, who found the following thicknesses of the strata down to the top of the lower greensand:—

	Feet.
Tertiaries, ...	324
Chalk, ...	586
Upper Greensand, . . .	72
Gault, ...	131
	1113

The base of the Gault was marked, as at Folkestone and other places, by the occurrence of phosphatic nodules, which left no doubt of its true geological horizon.

The agreement between the predicted and actual thickness of the strata is very close, and is the highest testimony that can be borne to Mr. Prestwich's accuracy and knowledge of the details of the London strata: but the unfortunate results of the boring, as shown in the following statement, prove how little aid the most skilful geologist (in the present imperfect state of the science) can render to the practical engineer. Every engineer is a practical geologist, but every geologist is not an engineer:—

"We are indebted, however, to the Hampstead Water-Works Company for the first attempt to solve this problem practically; but, as the surface of the ground at their Works at Kentish Town is 174 feet above Thames high-water-mark, the situation is not so favourable as might have been wished. A few years since this Company sunk a well through the Tertiary strata (at that spot 324 feet thick), to a depth of 215 feet in the chalk, making a total depth of shaft of 539 feet. The supply of water from this source being found insufficient for their purpose, the Directors of the Company, in 1852, consulted MM. Degousée and Laurent, the eminent well-engineers of Paris, on the advisability of sinking through the Chalk into the Lower Greensand. In November of that year these gentlemen came to London, and I accompanied them to those places in the neighbourhood of Merstham and Reigate where the outcrop of the chalk and underlying clays and sands is best exposed. The conclusion to which they arrived was precisely similar to my own, and on their report the Directors resolved to undertake the work. Accordingly, on the 10th of June, 1853, boring was commenced in the chalk at the bottom of this well.

"At a depth of 569 feet from the surface the chalk with flints ended; grayish chalk, without flints, becoming more argillaceous in descending, was then traversed for a thickness of 294 feet. The chalk-marl next succeeded, and continued for 47½ feet. This would give a total thickness to the chalk of 586 feet. The chalk-marl passes so insensibly into slightly sandy marls representing the Upper Greensand, and these into the Gault, that it is difficult to draw any satisfactory lines of division. I have taken as the representative of the Upper Greensand the more arenaceous and chloritic beds. They are 72½ feet thick. These strata, however, were here, on the whole, so argillaceous that they were not permeable, and they consequently afforded no additional supply of water. The Gault was found underlying the Upper Greensand in the usual order, and presented the ordinary character of a fine gray calcareous clay, 130½ feet thick. At the base of this mass of clay a layer full of the phosphatic nodules, so common at the base of the Gault at Folkestone and elsewhere, was met with.

"Thus far all the strata were in regular succession, and there was every reason to believe that the same order which prevailed at their outcrop, and with which there seemed to be nothing to interfere, would be continued underground; and that after traversing this band of phosphatic concretions, the light-coloured siliceous sands of the Lower Greensand would succeed. The ordinary probabilities of the geological sequence being maintained throughout this central area seemed then so strong, that when the works were at that point, just a year since, having occasion to speak on the subject at the Institute of Civil Engineers, I did not hesitate to express my conviction that a very few more turns of the auger would tap these sands. This opinion has unfortunately proved incorrect. Instead of meeting with loose sands, the next bed which presented itself was one of red argillaceous sand and sandstone, 1 foot thick: 12 feet of red clays (some mottled light bluish-green) and sandstones then succeeded; followed by a singular conglomerate, 2 feet thick, containing pebbles, of a considerable size, of various old and crystalline rocks: amongst these were dark gray syenites, greenstones, red claystone-porphyry, trap-rock, a grey semitranslucent quartz or hornstone, and a granular schist with traces of fossils. Then came 26 feet of red clays, underlaid by red sand and a bed of small rolled pebbles.

These were followed by 42 feet of alternating beds of very hard light gray and red sandstones, sometimes concretionary and calcareous, and of argillaceous reddish sands. Then by thick beds of red clay, with subordinate seams of micaceous red and light green sandstones and of reddish argillaceous sands, to a further thickness of 74 feet; ending at a depth of 1302 feet in a hard micaceous light-coloured sandstone.

"The only spring of water met with beneath the Gault was in the thin sand and pebble bed, No. 40. A rise took place in the water-level of the well of 3 feet when this bed was first reached, but it was not maintained.

"The bore-hole, which commenced with a diameter of 12 inches, was first reduced to 10, and then to 8 inches. It is tubed through the chalk, Gault, and the first 60 feet of the red beds, but the last portion of 128 feet is not yet tubed."

It is generally supposed that the Red Sandstones thus unexpectedly brought up to the base of the Gault belong to the new Red Sandstone beds, and that they may cover important carboniferous deposits beneath. It is difficult to understand, unless they are dislocated by strong east and west faults, why they did not supply water to this Artesian boring, and serve as a water-bearing stratum, as well as the lower greensand beds could have done. Mr. Godwin Austen expressed the opinion, before this boring was effected, "that the axis of the Ardennes was prolonged under the cretaceous series of the south of England, and reappeared again at the surface in Somersetshire; and he inferred that it was probable that the coal-measures might be found under part of the London Tertiary and Wealden districts." We can testify that this belief is shared by many who have no theoretical geological knowledge to adduce in support of their opinion.

We may yet live to see a coal-pit in Trafalgar-square replacing the hideous squirts of water which now disfigure it.

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1. The United States Grinnell Expedition, &c. By Elisha Kent Kane, M. D., U. S. N. New Edition. London: Trübner and Co. 1857.

2. Arctic Explorations in the Years 1853–4–5. 2 vols., 8vo. By Elisha Kent Kane, M. D., U. S. N. Philadelphia: 1856.

3. The Eventful Voyage of H. M. Discovery Ship "Resolute," &c. By George F. M'Dougall (Master). London: Longman and Co. 1857.

4. Journal of a Voyage to Baffin's Bay and Barrow's Straits in 1850–51, &c. By Peter C. Sutherland, M. D. 2 vols., 8vo. London: Longman and Co. 1852.

We purpose to confirm the theory of the Arctic Tides laid down in our last article on this subject, by the evidence collected in the books before us. The first of these books contains an account of the first American, or Grinnell, Expedition; and is principally remarkable from the cir-

cumstances connected with the drifting of the vessels in the pack ice for many months.

In September, 1850, the following vessels were assembled at Griffith's Island:—the "Resolute" and "Intrepid," the "Assistance" and "Pioneer," the "Lady Franklin" and "Sophia," and the "Advance" and "Rescue." The history of the "Lady Franklin" and "Sophia" is written by Dr. Sutherland; and that of the "Advance" and "Rescue" by Dr. Kane. In the latter book there is a chart of the path of the ships in the ice-drift, which appears to us to be conclusive as to the character of the tidal currents in the Wellington Channel. The unfortunate American vessels drifted up the channel with the ice, until, on the 2nd October, they attained a latitude of 75° 24′, in a position a little south of that which we have assigned as the place of meeting of the Arctic and Atlantic tides in this channel. On the occurrence of the spring tides, the ice floe drifted slowly to the south, and carried the vessels with it into Lancaster Sound, where they came under the influence of the permanent currents, which are continually employed in emptying Melville Bay of its load of ice, through that Sound, into Baffin's Bay. They wintered in the drifting pack, and were not finally released until June, 1851, off Cape Walsingham, in latitude 65°.

The following description of the commencement of this strange voyage in the ice is interesting:—

"The sound of our vessel crunching her way through the new ice is not easy to be described. It was not like the grinding of the old formed ice, nor was it the slushy scraping of sludge. We may all of us remember, in the skating frolics of early days, the peculiar reverberating outcry of a pebble, as we tossed it from us along the edges of an old mill-dam, and heard it dying away in echoes almost musical. Imagine such a tone as this, combined with the whir of rapid motion, and the rasping noise of close-grained sugar. I was listening to the sound in my little den, after a sorrowful day, close upon zero, trying to warm up my stiffened limbs. Presently it grew less, then increased, then stopped, then went on again, but jerking and irregular; and then it waned, and waned, and waned away to silence.

"Down came the captain: 'Doctor, the ice has caught us: we are frozen up.' On went my furs at once. As I reached the deck, the wind was there, blowing stiff, and the sails were filled and puffing with it. It was not yet dark enough to hide the smooth surface of ice that filled up the horizon, holding the American expedition in search of Sir John Franklin imbedded in its centre. There we were, literally frozen tight in the mid-channel of Wellington's Straits."

The observations on the phenomena of the ice-floe, illustrated as they are by excellent woodcuts, render this book of Dr. Kane's the most valuable contribution that has yet been made to our knowledge of the laws of Arctic ice-drifts.

The following is very suggestive:—

"This ice-opening was instructive practically, because it taught those of us who did not understand it before how capriciously insecure was our position. It revealed much, too, in relation to the action of the ice.

"1. The first crack was nearly at right angles to the axis of the channel; the subsequent ones crossed the first; the wind being in the one case from the westward, and afterward changing to the southward.

"2. The next subject of note was the disintegration of the old floes. It took place almost invariably at their original lines of junction, well marked by the hummocky ridges. This shows that the cementation was imperfect after seventeen days of very low temperature; a circumstance attributable, perhaps, to the massive character of the up-piled tables, which protected the inner portion of them from the air, and to the constant infiltration (*endosmose*) of salt-water at the abraded margins.

"3. The extent to which the work of super and infra position had been carried during the actions may be realized, when I say that the floe-piece which separated from us to starboard retained the exact impression of the ship's side. There it was, with the gang-way stairs of ice-block masonry, looking down upon the dark water, and the useless embankment embracing a sludgy ice-pool.

"We could see table after table, more properly layer after layer, each not more than seven inches thick, extending down for more than twenty feet. Thus, it is highly probable, may be formed many of those enormous ice-tables, attributed by authors to direct and uninterrupted congelation."

Dr. Kane's reputation as a writer is founded chiefly on his history of the second American Exploring Expedition; but it may be doubted whether his character as a scientific observer is not better established in his description of the first Expedition; which is far, however, from being a dry detail of facts and figures, as may be seen from the following:—

"To shoot seal, one must practise the Esquimaux tactics of much patience and complete immobility. It is no fun, I assure you after full experience, to sit motionless and noiseless as a statue, with a cold iron musket in your hands, and the thermometer 10° below zero. But by-and-by I was rewarded by seeing some overgrown Greenland calves come within shot. I missed. After another hour of cold expectation, they came again. Very strange are these seal. A countenance between the dog and the mild African ape—an expression so like that of humanity, that it makes gun-murderers hesitate. At last, at long shot, I hit one. God forgive me!

"The ball did not kill outright. It was out of range, struck too low, and entered the lungs. The poor beast had risen breast-high out of water, like the treading-water swimmers among ourselves. He was thus supported, looking about with curious, expectant eyes, when the ball entered his lungs.

"For a moment he oozed a little bright blood from his mouth, and looked toward me with a sort of startled reproachfulness. Then he dipped; an instant after, he came up still nearer, looked again, bled again, and went down. A half instant afterward, he came up flurriedly, looked about with anguish in his eyes, for he was quite near me; but slowly he sunk, struggling feebly, rose again, sunk again, struggled a very little more. The thing was drowning in the element of his sportive revels. He did drown finally, and sunk; and so I lost him.

"Have naturalists ever noticed the expression of this animal's phiz? Curiosity, contentment, pain, reproach, despair, even resignation I thought, I saw on this seal's face.

"About half an hour afterward, I killed another. Scurvy and sea-life craving for fresh meat led me to it; but I shot him dead.

"On returning to the ship, I found one toe frost-bitten—a tallow-looking dead man's toe—which was restored to its original ugly vitality by snow-rubbing. Served me right!

"Spent the afternoon in unsuccessful seal stalking, and in rigging and contriving a spring-gun for the Arctic foxes: a blood-thirsty day. But we ate of fox to-day for dinner; and behold, and it was good."

Turning from Dr. Kane to Dr. Sutherland, we cannot but express our regret that the "Lady Franklin" and "Sophia" did not find as skilful a narrator of their fate as the "Advance" and "Rescue." The doctors of the British exploring expeditions have not been more successful than some of the commanding officers; and in their attempts to convey a suitable

impression of some of the scenes they witnessed, they have occasionally degenerated into a species of fine writing, the effect of which is sometimes to confuse the reader.

Dr. Sutherland's book is too long, and although it contains many valuable observations on natural science, they have to be sought for in the confused details of sledge journeys, which are uninteresting except to those personally engaged in them. Dr. Petermann's Chart of the physical features of the Arctic regions, which accompanies the first volume, contains many points on which we do not yet possess sufficient data to form an opinion.

His indication of the probable route of the Franklin Expedition is singularly infelicitous.

The Appendix to the second volume contains valuable Tables of Temperature and Tides, and descriptions of the Algæ, Crustaceans, Echinoderms, and Silurian Fossils brought home by Dr. Sutherland. In the preparation of the Appendix the writer was assisted by Professors Dickie, Forbes, and Huxley; and by Mr. Gray, Dr. Baird, and Mr. Salter. The collection brought home and described is very valuable, and the new species are illustrated by two lithographic plates of the fossils, and by woodcuts of the new Entomostraca.

The regions visited by the "Lady Franklin" and "Sophia" in the Wellington Channel were exclusively composed of Silurian limestone,—a circumstance which accounts for the fact that there is not a single specimen described of the Carboniferous or Liassic fossils which were found by the more northern and western searching parties.

Dr. Kane's second Expedition is so well known that we do not feel it necessary to make any extracts from it, and we shall only make use of it to establish an additional fact in support of our theory of the meeting of the Arctic and Atlantic Tides, and our assertion that vessels attempting to cross this natural barrier will probably become permanently blocked up in the thick pack formed by the meeting of the opposing Tidal Currents.

Kane's Sea, on the eastern shore of which the "Advance" was abandoned, is a narrow strait, entered on the south by Smith's Sound, and on the north by Kennedy Channel. It is almost completely blocked up with heavy drift and pack-ice from 78° 20′ to 80° 15′ N. latitude; outside these boundaries, to the south and north, there is open water, caused, as we conceive, by the rapid tidal streams of the Atlantic and Arctic Polar seas.

At Cape Andrew Jackson, where the open water to the north is first met with, the current of the tide runs south and north with great rapidity. In the words of Mr. Morton—

"The tide was running very fast. The pieces of heaviest draught floated by nearly as fast as the ordinary walk of a man, and the surface pieces passed them much faster, at least four knots. On their examination the night before, the tide was from the north, running southward, carrying very little ice. The ice which was now moving so fast to northward seemed to be the broken land-ice around the Cape and the loose edge of the south ice."—Vol. i., p. 288.

The unfortunate "Advance" was beset by the pack ice, a few miles inside the southern boundary of the great mass of permanently fixed ice which fills Kane's Sea within the limits already specified. All her efforts to get further north failed; and she was ultimately abandoned in Rensselaer Bay, in the same manner that the "Investigator" was left by Sir Robert M'Clure in the Bay of Mercy. We believe that the solid ice of Kane's Sea is due to the meeting of the Arctic and Atlantic Tides, and that if this barrier were once crossed, it would be possible to find permanently open water to the north, such as we know exists to the south, in Baffin's Bay.

The last book on our list of Arctic Voyages at present is the well written and highly interesting narrative of the voyage, abandonment, and recovery of H. M. S. "Resolute," by Mr. M'Dougall. The tides at Dealy Island were carefully observed by Mr. M'Dougall, who states the time of high water at the full and change at $1^h\ 39^m$ to $1^h\ 48^m$.

We have collected from various sources, kindly placed at our disposal by Arctic officers, the means of making the following Table, reduced to Greenwich time, which shows the progress of high water to the westward from Lancaster Sound towards the meeting of the tides in Banks' Strait:—

True Establishment (*Greenwich Time*).

	H.	M.
At Leopold Harbour,	5	45
Assistance Harbour,	6	16
Griffith's Island,	6	5
Dealy Island,	9	8

From this Table it is pretty evident that the time of high water, at full and change, at the head of the tide, or point of meeting, is at 10 or 11 o'clock; in fact, at much the same time as the high water at the corresponding meeting of the tides in the Irish Sea and Strait of Dover.

The Wellington Channel forms an *offset* bay, like the Bristol Channel or the Gulf of St. Malo. It is filled quicker by the tide than Melville Sound. The following observation is highly important in its bearing on the true theory of tidal currents in the Wellington Channel:—

"24th. Mr. Court (acting master) left with a party of four men, to watch the tide at a crack about three miles west of Beechey North Point.

"He returned on the 26th, and reported the flood tide set to the northward, and continued doing so two hours after the time of high water at Beechey Island. He found the length of flood and ebb nearly equal, but the strength of the former was much greater than the current of the latter."

From the fact that the tidal stream sets for two hours to the north, up the Wellington Channel, after the time of high water on shore, the analogy to the southern half of the Irish Sea is apparent.

Our limits do not permit us to make more than a few extracts from Mr. M'Dougall's book. Our first is the account of Mecham's discovery of drift wood in Prince Patrick's Island:—

"Retracing their steps a short distance, advantage was taken of a strong N. W. gale to steer boldly across the land, in a southerly direction, in order to avoid the circuit round Land's End, as also the execrable road. For some distance they travelled over a dreary plain, without a single object to relieve the eye; but at length they unexpectedly found themselves amongst ravines; and although by having to follow their tortuous windings, their work was increased, it proved an agreeable relief to the monotonous level. In one of the ravines, a tree, protruding some ten feet from a bank, was discovered; it proved to be four feet in circumference. In its neighbourhood, several others were seen, all of them, be it remarked, of the same description as that found on Cape Manning. A second tree measured four feet in the round by thirty feet in length, and a third two feet ten inches round. Several pieces were sawn off as specimens and fire wood. In appearance, Mr. Dean, our carpenter, declares it resembles larch, but in weight it bore a stronger resemblance to lignum vitæ, or iron wood; the additional weight was imparted by the soddened state in which it was found. When comparatively dry, it was tried as fuel, but its virtue had gone; it threw out little or no flame, but smouldered rather than burned, like so much tinder. The position of this decayed forest (for three trees in this country I consider entitled to the distinction) was, by supposition, about 400 feet above the level of the sea, being on the first step (descending) of the plateau, considered to be between 500 and 600 feet elevation. The trees were found in lat. 76° 12′ N., long. 122° W. near the head of Walker Inlet."

The loss of the "Breadalbane" transport ship has been frequently mentioned, and is thus described:—

"On the 20th August, the wind blowing strong from the S. E., the 'Phœnix' and 'Breadalbane' were secured to a driving floe, about half a mile south of Beechey Island. The ice from the offing closed, and so effectually crushed the transport as to complete her destruction in the short space of fifteen minutes; the 'Phœnix' narrowly escaping a similar catastrophe. And here I would respectfully call the attention of the theoretical *savants* to the fact that in the short space of a quarter of an hour, a vessel capable of navigating the globe disappeared beneath the surface of the sea, by the almost mysterious power of a field of ice. The accident occurred at night, and was so unexpected, that the agent narrowly escaped with his life, being obliged to rush on deck, and scramble to the floe in almost a state of nudity. The 'Breadalbane,' however, I must admit, was a *hired* transport, and was not strengthened, as she ought to have been, like all other arctic ships, and the agent had never been in the ice before."

The following we believe to be a fair account of the courts martial, which terminated in the somewhat dubious acquittal of Sir Edward Belcher for abandoning so many ships in the ice;—a step the propriety of which has certainly not been rendered more clear by the fact that the abandoned "Resolute" found her own way through the dangers of Lancaster Sound and Baffin's Bay, and is now quietly rotting in one of her Majesty's dockyards:—

"The abandonment of so many ships naturally excited great interest and much discussion, and the proceedings of the court martial, which, as a matter of course, was held on the various officers in command, were watched with no common interest.

"The Court was held on board the 'Waterloo,' at Sheerness, and occupied three days, viz., the 18th, 19th, and 20th October. Admiral the Hon. George Gordon presided; the other officers comprising the Court were Captains Sir Thomas Pasley, of the 'Royal Albert;' Wyvill, of the 'Wellesley;' Tucker, of the 'Formidable;' Keith Stewart, of the 'Nankin;' Seymour, of the 'Cumberland;' and Fanshawe, of the 'Cossack.' Mr. W. W. Hayward officiated as Judge-Advocate.

"The first case proceeded with was the abandonment of the 'Investigator.' Her captain, the present Sir Robert L. M. M'Clure, justified his leaving his ship by producing written orders to that effect, from his senior officer, Captain Kellett.

"The prosecution in this case being merely nominal, occupied but a short time. The verdict of the court, after a short absence, was to the effect that Captain M'Clure, and the officers and crew of the 'Investigator,' deserve the highest commendation for their exertions, and that each and all were fully acquitted.

"The Admiral, in restoring Captain M'Clure's sword, observed: 'The Court are of opinion that your conduct throughout your arduous exertions has been most meritorious and praiseworthy.'

"The court then proceeded to inquire into the cause and circumstances attending the loss of the 'Resolute.' Captain Henry Kellett, C. B., being asked if he had any statement to make, pleaded orders produced from Sir Edward Belcher, C. B., ordering him to abandon the 'Resolute' and her steam tender 'Intrepid.' Extracts from several letters bearing on the abandonment, some of them being marked confidential, were then read by the express order of the Court. One letter from Sir Edward Belcher to Captain Kellett, dated on February 7, 1854, contained a 'request' that Captain Kellett would, with the officers and crews of the 'Resolute' and 'Intrepid,' meet Sir Edward at Beechey Island before the 26th August. To this letter Captain Kellett replied that he had come to the conclusion, that nothing contained in his orders would justify him in abandoning the ships under his command; and, therefore, begged Sir Edward Belcher (who was in possession of the orders from Government), to send him 'final, decided, and most unmistakeable orders,' and further, in a private letter of the same date, Captain Kellett declared it to be the unanimous opinion of all on board the 'Resolute,' that they would not suffer from the first break up, as the ice was only of the previous year's formation.

"To these letters Sir Edward returned an answer, dated April 21st, directing Captain Kellett to withdraw everything valuable from the ships under his command, and with the officers and crews to proceed for further instructions to Beechey Island.

"This order released Captain Kellett from all responsibility connected with the abandonment, and the Court returned a verdict of honourable acquittal to Captain Kellett, the officers, and crew. The admiral restored Captain Kellett's sword, observing that he experienced much satisfaction in returning a sword which the owner had worn with so much credit, satisfaction, and advantage to his country.

"The trial of Sir Edward Belcher then commenced, and after the examination of various witnesses for the prosecution, Sir Edward read a lengthened and clever defence, in which he touched on all the occurrences of the voyage likely to justify the determination he ultimately arrived at. He also quoted various authorities, and read long extracts from his instructions bearing on the subject.

"After the defence, the Court remained closed for an hour and a half; at the end of that time the Deputy Judge-Advocate read the finding of the court, which was to the following effect:—

"'The court is of opinion that the abandonment of H. M. S. "Investigator" was directed by Captain Kellett, who was justified in giving such order. The Court is further of opinion that, from the great confidence reposed in Captain Sir Edward Belcher by the Lords Commissioners of the Admiralty, and the ample discretionary powers given to him, he was authorized and did not act beyond his orders, in abandoning H. M. S. "Assistance" and her tender "Pioneer," or in directing the abandonment of H. M. S. "Resolute" and her tender "Intrepid;" although, if circumstances had permitted, it would have been advisable that he should have consulted with Captain Kellett previously. And the Court doth adjudge the said Captain Sir Edward Belcher to be acquitted, and he is hereby acquitted accordingly.'

"The President then returned Sir Edward Belcher his sword, and the Court broke up."

Mr. M'Dougall's preface contains the following remarks on a subject which now anxiously engages the attention of all who wish to know the particulars of poor Franklin's fate, or who feel an interest in the brave sailors of the "Fox:"—

"Even now, whilst I write, Captain M'Clintock is again preparing to prosecute another voyage, in hopes of clearing up the mystery of the fate of the crews of the 'Erebus' and 'Terror.' A screw steam yacht—the 'Fox'—has been pronounced admirably adapted

for the service, the *beau-ideal* of an Arctic vessel of the present day, with a bow as sharp as a knife, the very reverse of the old school, and is now fitting out at Aberdeen at the expense of Lady Franklin and other promoters of her noble undertaking.

"May her unparalleled efforts to obtain tidings of her brave husband and his gallant companions be attended with the results so ardently desired; and if success can be obtained, Captain M'Clintock is, under Providence, the man to command it!

"The good wishes of every civilized nation will attend the expedition now setting forth from our shores; and may all who comprise it be restored to their homes in unimpaired health, and successfully accomplish the object of their glorious mission!"

Correspondence.

TO THE EDITORS OF THE NATURAL HISTORY REVIEW AND QUARTERLY JOURNAL OF SCIENCE.

GENTLEMEN,—The fact of your having honoured my "Omphalos" with a notice in your Journal would not, in the smallest degree, have entitled me to be heard at your bar. But as you have opened your pages to a somewhat hostile protest against your verdict, I venture to ask the courtesy of a page or two, not so much for a rejoinder to your respected correspondent, Mr. Jukes, as for a few thoughts supplementary to my treatise.

It is asserted by geologists, and generally accepted as an undeniable truth, that this world had a history of immeasurable duration, with many successive races of plants and animals, before man appeared on the scene. The reception of this doctrine rests on two other assertions,—the twin pillars on which the edifice stands, and which are assumed to be equally stable. First, that the stony records of the earth's crust, patent to sense, *absolutely compel* us to assent to this long chronology; secondly, that the Word of God does *not absolutely compel* us to reject it.

The former of these propositions I have considered in "Omphalos;" in which I have endeavoured simply to prove that the facts do *not absolutely compel* the conclusion in question; that another solution is, at least, *possible.* The object of the book has been greatly misunderstood; and my argument has been pronounced a failure, because I have not *proved* the prochronism of the world. But I never proposed to prove this; it was enough for me to show that the law *existed* in creation; and to prove the possibility—the bare possibility—that it might have been an *universal* law.

But though this was enough for me to accomplish in regard to my self-imposed task in "Omphalos," I have since seen that it was not enough in regard to the general question. For the reply is obvious:—"Granting your conclusion as to the bare possibility that the long chronology may be false, yet the voices of ten thousand witnesses impart so immense a preponderance of probability in its favour, that it would be

absurd to give up the belief in it for a bare possibility." And I do freely concede this vast preponderance of probability, supposing that the physical facts afford the only source of our information.

But Christians cannot forget that there *is* another, and a quite independent source of information. Information on the very subject—not incidental only, but direct and historic; not confined to generals, but descending into copious details—has been given by One infinitely competent to instruct us; One to whom mistake is impossible; One in whom there is no darkness at all. What, then, saith the Scripture? And if it can be shown that the Word of the "God that cannot lie" is utterly irreconcilable with the hypothesis, the mind which is subject to Christ will not hesitate a moment in preferring the *possible* solution which agrees with the written Word, to the *probable* one which sets it aside.

It has been customary for disputants to rest the question, so far as the Revelation of God is concerned, upon the six-day statements in Genesis i., and one or two parallel passages in the Decalogue and in the Psalms. But this is needlessly to narrow the ground of inquiry. I am content for the present to waive these passages altogether, and to put the issue on the broader ground of the grand counsels of God concerning his Son, which are developed throughout the Word; and especially that glorious purpose which has determined "to gather together into an head" (*ανακεφαλαιώσασθαι*) all things in Him, as Son of Man (Eph. i. 10).

With this purpose Creation is inseparably connected; and I think I may venture reverently to affirm, from what is revealed in the Scriptures, that this world could never have existed otherwise than in direct and manifest subordination to a Human Headship. A world full of sentient beings, without a responsible, intelligent Head, is an idea wholly foreign to all that the only wise God has made known to us of his plans. His works are marked by the most perfect order and rule; and there is an unity in his plans which enables us to argue from one to another. No sooner was the present constitution of things prepared, than a Head was placed over it, to have dominion. In this consisted, there can be little doubt, that "image of God" in which the Head was made (cf. Ps. lxxxii. 6; John, x. 34, 35); he was to Creation a Vice-God, if I may use such a term; God's representative and vicegerent; God's rule being vested in him. This Head was Man; and yet not Adam, individually and personally, so much as the progenitor of a race; for, by a careful comparison of Gen. i. 28, Ps. viii. 6, and Heb. ii. 6–9, we find that there was involved in the headship a certain "*Son* of Man," whom the Holy Ghost explains to mean the Lord Jesus. And so we see that, as it is elsewhere affirmed (Col. i. 16), "ALL things were created" not only "by Him," but "*for* Him."

I believe this federal connexion of Creation with Humanity to be a fact of the utmost importance to the understanding of the claims of Geology. I am amazed that Christians generally have ignored it, and allowed judgment to go by default, when they had an impregnable position, which they might have defended against all assailers.

God's purposes are immutable and irrefragable. "His counsel shall stand, and He will do all his pleasure," however circumstances and creatures may *seem* to frustrate it. And this unity and immutability of design preclude the supposition that Creation could ever have had any other Head than Man. If, in former ages, the dominion of this world had been vested in some other race—corporeal or spiritual—that headship must have been displaced for the human; which hypothesis seems scarcely reconcilable with the declaration that "all things created, visible and invisible, were created—*for Him*" who is "the first born of the whole creation"—πρωτότοκος πάσης κτίσεως.

We may with reverence predicate what God would do or would not do under certain circumstances, from what He, the Immutable, has done. Look at what actually occurs in circumstances parallel to those of the suppositious case of a former unknown Head falling into apostacy. Adam fell from his allegiance, and thus lost his place of rule. What does God do? Does He displace Man, and set up another dynasty? No: God never acts thus. He stablishes the dominion in the person of his own beloved Son. The dynasty of Man as Head of Creation can never be removed, but it must be vested in another person; and God becomes Man, in order that the counsels of God may stand, and the headship be no more liable to lapse.

This grand plan of the redemption of Creation was no after-thought, no device to patch up what had unexpectedly been spoiled; but the great end for which all things were originally made. From all eternity, in the Divine prescience, "ALL things were made for" Christ; and from all eternity the human "body" was "prepared" for Him (Heb. x. 5).

But geologists assure us that Creation—material creation, animals and plants on this very earth of ours—existed millions of ages before the headship of Man commenced. Nay, more; that Creation went on *in ruin*, for these countless periods; that vanity, suffering, pain, rapine, and death, was the undeviating rule. Nay, more; that there was an indefinite succession of universal ruins; that creation succeeded creation, fauna after fauna, race after race, through those doleful ages,—every one of which, without a solitary exception, fell into ruin; nay, *never knew anything else but ruin*. Shall Christians have such thoughts of God as this?

Perhaps it may be replied,—"But do we not see a creation actually going on in ruin around us?" Most surely we do. But Revelation fully explains the otherwise astounding fact. Indeed, if the Word had not distinctly stated anything on the subject, I think we should be amply warranted in inferring the revealed conclusion. I take it to be an incontrovertible position, that, in a perfect government—such as that of God must be—there never could be suffering except as the result of sin, sin personal or sin putative. Wherever we see suffering, we have a right to assert, "That being has sinned, either personally, or in its representative, with whom it is identified in the Governor's sight." This position seems to me impregnable; because, to suppose a creature suffering, except as the result of sin, is necessarily to impugn either the power or the justice of the Creator. There is an implied compact in the relation

of the Governor and the governed, that, so long as they render Him obedience, He will protect them from suffering.

But we are not left to reason out this conclusion. The Holy Ghost (Rom. v. 12, *et seq.*) distinctly affirms that death entered into the world through (διὰ) sin. And though I know that this is predicated of *man* primarily (perhaps exclusively), yet the important principle is here affirmed (ver. 14), that death is the result of *imputed*, as well as of *actual*, sin. Why do infants suffer and die,—infants a day old? In the same Epistle, however (viii. 19–22), the very same principle is applied to the external creation (ἡ κτίσις). It is declared that "the creation waiteth for the manifestation (ἀποκάλυψιν) of the sons of God, in hope that the creation itself shall be delivered out of the bondage of [consequent on] the lapse, into the liberty of [consequent on] the glory, of the children of God." Here I may observe that in the Greek it is very manifest that the member of the sentence —— "of the children of God," is equally pendent on the preceding members,—"the bondage of the lapse" and "the liberty of the glory." I say "*equally* pendent;" by which I mean, that we are required constructionally to fill up the ellipsis thus,—"from the bondage of the lapse of the children of God, into the liberty of the glory of the children of God." "Children," either in the sense that Adam was a "son of God" (as in Luke iii. 38), or, more probably, anticipatively (as in Heb. ii. 14).

Here, then, it is implied that the groaning and travailing of "the whole creation" is a slavery (δουλεια) flowing out of the lapse of the sinning, but redeemed race; and that it will be removed when the last traces of the curse are lost in *their* hastening glory.

But, in a parenthesis thrown into the passage above-cited, this federal connexion of the Creation with Man is more broadly stated. As a reason why the creation waits for the "apocalypse of the sons of God," it is said,—"For the creation was subjected to vanity [helplessness, suffering, death], not willing [not exercising any will in the matter], but *through him who subjected it*" (ver. 20). And this could be none other than Man, its federal Head, in whose standing or falling it stood or fell.*

Geology, however, asserts that death—violent, painful death—was in the world through uncounted ages before Man existed. Of whose sin, then, was all this "vanity" the result? Of the creatures' own sin?—the sin of the Plesiosauri, of the Belemnites, of the Corals? If not, if *personal* sin is out of the question when the sufferer is a Cephalopod or a Zoophyte, then, whose sin was imputed to them? Sin, the sin of some responsible being, must have preceded the suffering; and the sin of some being who stood in federal relation to the sufferers. But a federal Head of Creation, other than Man, could not have been; for this would be to

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* Of course I am aware that other interpretations of this passage have been given, some supposing τὸν υποτάξαντα to mean God Himself; others, Satan. But I am persuaded that no other is in the slightest degree relevant to the Apostle's argument than that which makes Adam the person signified.

set aside the headship of Jesus—the Son of Man—as the object of the eternal, unchangeable purpose of God the Father.

But I press the difficulty of death farther yet. Geologists tell us that many species of animals found in the strata of the later pre-human eras are absolutely identical with those which at present inhabit this world. Thus, the older Pliocene formations of the Tertiary period contain existing species to the amount of 60 to 70 per cent. of the whole (Lyell, in Geol. Proc., 1841). Among these are all the three species of Deer now inhabiting these islands, the ancestors of which were contemporaneous with the Mammoth of Siberia, and with the great Cavern Bear, and the fossil Tiger of the Yorkshire caves.

Now, suppose a Christian geologist and myself chanced to be walking on Ascot Heath at the moment when the royal hounds had brought a noble stag to bay. We witness the distress of the animal; his vain efforts at escape or defence; his agony as the life-blood pours from his throat under the fangs of his assailants; and his convulsive throes of death. I ask my friend, "Whence come the sufferings of this creature, incapable of personal sin?" He would doubtless answer, being a Christian, "Death is entailed upon its race because of the fall of Man, its federal Head." No other answer could be given, since there can be no exception to the category of "the *whole* creation," or "*every* creature" (πᾶσα ἡ κτίσις), which is spoken of as involved in Man's lapse, and waiting for Man's glory.

But I rejoin to my friend,—"*That* cannot be; for you tell me that this race of stags has been dying, generation after generation, ever since the middle Tertiary period; that is, long ages before Man was created. Death certainly did not come upon the red deer as the result of Adam's sin, since it was already a dying race long before."

I do not see what answer he could make. If he should assert that some previous Head of Creation had entailed death on the cervine race, I would reply, that (waiving the objections I have already brought against such a hypothesis, as subversive of the headship of the Lord Jesus) this would involve the absurdity of the creatures' surviving the dynasty of their representative, with whom they had been identified, and carrying the punitive results of *his* sin into the dominion of a *new* federal Head. It would involve, too, the intolerable supposition, that, from day to day, when God, surveying his handiwork in detail, pronounced it good, and at the close of the sixth day took an infinite complacency in it as a whole,—in that, "behold it was *very* good,"—death was already lording it over many of the creatures, and had been doing so all along, transmitting into this new creation the ruin and decay of a former one!

Probably I shall be met with the hackneyed remark, "the Bible is not intended to teach us science." How few who make this remark know what the Bible really *is* intended to teach! It is not a mere code of laws: it is not a book of ethics. Neither is it, as many Christians seem to think, a mere book of instructions to man, as to how he may be delivered from the wrath to come. Blessed be God! there is this in it; but, oh! this is far short of the mind of the Holy Ghost in revelation.

The great subject of the Bible is CHRIST. God is occupied with the glory of his beloved Son Jesus, and the matter revealed in this precious book is the development of that glory, and specially in connexion with the earth. It is the glory of the Son of Man, as Head of Creation; and, therefore, nothing connected with Creation can be said to be foreign to the Bible, or to be out of place, when the Father condescends to reveal the Son.

Others may go to the Bible for what is called "theology," and to nature for "science." I cannot divide them. I cannot look at the Bible with one eye, and at nature with the other: I must take both together, but always giving the Word the paramount authority. People may continue to say, if they please, that the Bible is obscure, but that nature is clear. Have they studied the former as fully, as ardently, as sincerely, as they have done the latter? Mr. Jukes casts it at me as a reproach that I assume to have some acquaintance with the mind and ways of God. Shall the Ever-blessed One condescend to make known his mind to his creatures, and yet it be wrong for me to think that I can know it? Mr. Jukes speaks of the "reverent man" "only pondering silently in his most solemn and meditative moods" on certain "secrets and mysteries." Ah! I shall never guess out the thoughts of the High and Lofty One in that way. I prefer to come to his own Word, his own Book, written by Himself expressly for my instruction; and there I find many things, that else would have remained "secrets and mysteries," made transparent as a sunbeam. The charge of treating the things of the Blessed God with flippant familiarity is a far more serious one than that of defective logic; but is not the gravamen of my offence this, that I endeavoured te depict graphically and palpably that which God Himself has so presented to us, instead of shrouding it in an obscurity which would warrant us in politely bowing it aside out of our consideration?

The revealed Word distinctly states that animals and plants were created in full adult vigour:—great whales; moving creatures with life; winged fowl; cattle; creeping thing; every plant of the field "before it was in the earth;" and every herb "before it grew." Therefore I am sure these objects bore evidences of prochronic development. Since this *was* the case with organic creation, it *may have been* the case with inorganic,—with the world itself. Geologists say that this is altogether improbable. What of that? Is it *possible?* If they cannot deny the possibility, then the ground is cut from beneath their feet. Against the *certainty* of a short chronology, they bring the *probability* of a long one. I have sought to show that the Word of God absolutely compels me to the short chronology; I have sought to show that physical phenomena do not absolutely compel me to the long one.

I am not at all sure that prochronism is *the true and actual* solution of the geological difficulty; but I am sure that it affords *a tenable* solution. It is enough for me that it affords me an escape from the dilemma on whose horns the geologists would impale me. It is not pleasant, of course, to see your antagonist creep out, when you thought you had got

him into a corner; but there is the outlet,—*an* outlet, I mean. Others may discern other outlets: I see that prochronism is *one*, and there I creep out, and betake myself to my refuge, the Word of the unlying God.

It has been charged against my book that it makes God a "*Deus quidam deceptor*;" that I represent God as telling a lie. Far be it from me! He cannot be tempted with evil, neither tempteth He any man. There would be some plausibility in the charge if I had represented God as giving no information on creation except in the things created. But He has given it fully and explicitly, in his Word. Parrhasius might have been called a deceiver when he painted a curtain with such perfection of art that his rival thought it real; but would you have charged him with falsehood if he had affixed to it this label in legible characters—"I have produced this effect by laying paint upon canvass"? I might, perhaps, make another sort of reply to this charge, in full conformity with Scripture; but I fear it would be little palatable to many, and I forbear.

I am not so simple as to suppose that the arguments which I have essayed to bring forward in this communication will meet with general concurrence. The world, whether called "Christian" or called "Heathen," knows nothing, and cares nothing, about the glory of Christ. But I solemnly appeal to real Christians; to those who have received eternal life in the Son, and who know that they have received it; to those who have been "called into partnership (εἰς κοινωνίαν) with Jesus Christ our Lord;" to those who are joint-heirs with Him of the coming glory. I appeal to *them*, and beseech them to reconsider how far they can consent to accept scientific conclusions—at best but the deductions of reason from the evidences of sense—whose tendency is to dethrone the Lord Christ as Head of Creation, and to give the lie to the Revelation of God.

I remain, Gentlemen,

Yours very respectfully,

P. H. Gosse, F. R. S.

[We publish the above answer to Mr. J. Beete Jukes' letter (*vide* page 106) without comment, reserving our judgment on both letters, with which we will conclude this subject, until our next Number.—Eds. N. H. R.]

Handbook of the British Flora, &c. By George Bentham, F. L. S. London: Reeve. 1858.

An entirely new British Flora is, indeed, a novelty in botanical literature, such as has not appeared within the memory of the present generation. British plants have been described and re-described under many forms, either in general or local Floras, and the same dish been served up, with new sauces, till we are wearied with its repetition. One would hardly suppose, therefore, that there were room in a field so well trodden for a new candidate for distinction. And yet the space is ample; for, till now, the ever recurring question, "What book do you recommend?" could not be satisfactorily answered. The faults of previous Floras have been either that their matter was needlessly spun out, or so condensed and incumbered with technicalities, that a student found it difficult to comprehend; or, too often, that one author had confidingly transferred to his own pages the descriptions of his predecessors. Thus, in many cases, errors were perpetuated, and frequently increased, little by little, by successive copyings and adaptations. The "Flora Britannica" and subsequent writings of Sir James Smith were the nucleus from which several more recent Floras were derived.

Hooker's "British Flora" succeeded Smith, the author adopting most of Smith's species, but condensing the matter, changing the plan from the Linnæan to the natural arrangement, and adding several illustrative plates of the more troublesome genera. The latest edition of this work, edited by Dr. Walker Arnott, though changed in some respects, retains the greater portion of the original matter, and, with the preceding editions, can only be regarded as a "cultivated variety" (so to say) of the original stock, the "Flora Britannica." To the same stock may be referred, perhaps, the majority of the local Floras.

Babington's "Manual," which latterly has contested the field with Hooker and Arnott, claims another parentage, the limits of species adopted and advocated being more in conformity with the views of some European botanists than of the British school. This author has very carefully elaborated his subject, and though we cannot subscribe to his deductions, we should be unjust to withhold the praise due to painstaking and laborious research, with an earnest desire to elicit the truth of nature. In vol. iv., p. 39, we have noticed the latest edition of Mr. Babington's work, which may be recommended to all those interested in the study of varying local forms of our wild plants.

Mr. Bentham's "Handbook," now before us, is a very different work from those of Smith, Hooker, or Babington, and, in our judgment, supplies a want which none of them have successfully met. It addresses itself not merely to the botanist by profession, but to the uninstructed student; and it speaks in language so clear and intelligible, that by its help, with common care and attention, a knowledge of our native plants may readily be acquired by any one. The *terminology* of the science, so indispensable, but so troublesome and repulsive, to the student, is clearly, though briefly, explained in the Introduction, and sufficiently

detailed to obviate the necessity of any more extended *preliminary* instruction before the Flora begins to be freely used. Botany has never yet been learned from reading books, or from hearing lectures, and, by its nature, it never can be so learned. The student must observe plants themselves, and study their forms and the structure of their parts before he can acquire any real knowledge of their relations. A certain amount of botanical verbiage may be crammed from books, but a student who is ignorant of specimens is ignorant of Botany. Hence it is desirable that, as soon as possible, he pursue his studies in the field. To enable him to do so with profit, he must understand the phraseology of a Flora; and the thirty-five pages of matter prefixed to the "Handbook," if carefully read and mastered, will be found amply sufficient as a commencement, to which afterwards more extended physiological and structural details, gleaned from larger introductions to Botany, can be added.

After the Introduction, is given an "Analytical Key to the Natural Orders and Anomalous Genera of the British Flora," to assist the student unacquainted with the natural system in tracing the position of his plant in its order; and from the manner in which this "Key" has been drawn up, we feel confident that the beginner's main difficulty in using a modern British Flora has been successfully overcome. The difficulties which strike the beginner who opens a book written on the plan of the natural system are, the number of the Orders, the length and complicity of their diagnostic characters, and the minute points of structure which distinguish one from another, particularly the constant reference to the structure of ovules and seeds. In the "Key" the most obvious characters have preference, and very rarely indeed are characters brought forward which require more than common care, with the help of a pocket-glass, to observe. Similar analytical keys are introduced throughout the work, not only for the genera of every natural order, but for the species of every genus, when more than one; and it is this feature of the book which so greatly recommends it to the use of students, who are thus saved the trouble of wading through long descriptions, and directed at once to the characters which they ought particularly to notice in the plant before them. Take, for example, the following analysis of the genus Potentilla, p. 192:—

Leaves digitately divided.
- Flowers white, ... 1. *Strawberry-leaved P.*
- Flowers yellow.
  - Petals 4 in all, or nearly all, the flowers, ... 3. *Tormentil P.*
  - Petals 5 in all, or nearly all, the flowers.
    - Leaves very white underneath, ... 4. *Hoary P.*
    - Leaves green on both sides.
      - Stems creeping, and rooting at the nodes, . . . 2. *Creeping P.*
      - Stems short, and tufted or procumbent, but not rooting, 5. *Spring P.*

Leaves pinnately divided.
- Flowers dingy purple, ... 9. *Marsh P.*
- Flowers white, ... 8. *Rock P.*
- Flowers yellow.
  - Stem much branched, often shrubby, leaflets few, oblong, 6. *Shrubby P.*
  - Stem creeping, leaflets numerous, silky underneath, . 7. *Goose P.*

It will be observed, in the above table, that *English* names are used. In the text the Latin name is also given, but appended to the English. We do not think this preference for bastard-English names—for they are often nothing more—is of any advantage to the student. It is as easy for the most unlettered person to learn to say "Potentilla" as "Potentil;" "Epilobium," as "Epilobe;" "Trientalis," as "Trientale;" nor do we think these names improved in sound in their *Benthamic*, we cannot call it Anglican, form. The author's reasons for adopting English names are partly given in the Preface (p. xiv.), where a fuller explanation is promised to be shortly laid before the Linnæan Society, together with details on "the limitation, character, and synonyms of the genera and species." If the introduction of barbarous names be a blemish, it is the chief one which we notice in the work, the plan and scope of which are excellent; and its general execution such as might be expected from a botanist of the ample experience and acumen of Mr. Bentham. The admirers of "critical species" will probably be distressed at finding many of their favourites erased altogether, or reduced to varieties; but we at least are thankful to be permitted once more to call the Blackberry a Blackberry, instead of hunting it through six-and-thirty aliases; and to have but five wild roses to remember instead of thirteen, although our *Rosa Hibernica* be one of the slaughtered innocents. We have not critically examined Mr. Bentham's excisions or reductions, but they amount to about five hundred,* which, in a Flora so limited as the British, is a tolerable item. When a *Species Plantarum* comes to be written on similarly comprehensive principles, we may reasonably hope to see the list diminished at least in equal proportion.

The advanced botanist, as well as the intelligent student, will be pleased to find under each genus and species throughout the work a short notice of the geographical ranges. This is an important element in a Flora like that of the British islands, which contains so few strictly local forms, and is so largely composed of species having wide geographical distribution. Those who are unacquainted with the elaborate "Cybele Britannica" of Mr. Hewitt Watson will find this portion of the work peculiarly valuable. The Irish habitats are less fully given than we could desire; but this is the fault, not of Mr. Bentham, but of our Irish observers, who have yet to work out and make known the vegetable riches of a large portion of the island. We know that Mr. Bentham is very desirous of obtaining information of Irish habitats discovered since the publication of the "Flora Hibernica," in order to include them in a second edition.

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* In Babington's "Manual" there are 1708 species; in Hook. and Arn. 1571; and in Bentham's "Handbook," 1285.

The Aquarian Naturalist: A Manual for the Sea-side. By Thomas Rymer Jones, F. R. S., &c. Eight coloured plates. London: John Van Voorst. 1858.

Here we have another book on the Aquarium and its inhabitants, from the pen of the distinguished Professor of Natural History and Compative Anatomy in King's College, London, containing descriptions, more or less imperfect, of many of our native marine animals; numerous quotations from the writings of various British naturalists; together with a considerable amount of poetry, and eight coloured plates executed by Mr. Tuffen West.

The plan of the work is in many respects defective, and the several animal groups described therein are treated of in a very unequal manner. Thus, the Gasteropodous Mollusks are dismissed in eighteen pages; the Fishes, in less than nine; whilst upwards of eighty-four are occupied with descriptions of the Marine Annelida.

The style of the author is sufficiently varied, being sometimes agreeably colloquial, at others, tediously verbose. He is prone, moreover, to indulge in occasional digressions from the more immediate subject of his work, and to enter on the discussion of topics which would seem, at first sight, to have but little connexion with marine zoology, such as the nature and application of the Baconian philosophy, the legendary records of St. Hilda, and the noisy clamouring of cockatoos. These digressions are, in our opinion, the best written portions of the book. They are, in short, well calculated to display the nature of the extensive course of reading which Professor Jones must have undergone in order to prepare himself for the production of the volume before us. We may add, that he possesses a more than ordinary acquaintance with the manifold mysteries of Pagan mythology, and invokes, with due solemnity, and in their proper order, the shades of Cheops, Apicius, and Tartarus.

But, notwithstanding the frequent allusions made by our author to the "froth-fringed margin of the sea," the "foam-crowned billows," and the "silent shore," it is still evident that he possesses a very superficial acquaintance with many of the objects which he professes to describe. Thus, for example, in his account of the Echinodermata he tells us that—

> "Amongst the most interesting decorative and characteristic occupants of the marine vivarium must be enumerated the various species of Star-fishes, properly so called, constituting the great genus Asterias of modern zoology, &c."

And again, that—

> "The Northern Sea-star, the species most common upon some of our coasts, is among the largest, the most powerful and ravenous of its kind, sometimes measuring, when completely expanded, twelve inches between the tips of the opposite rays. The colour is extremely variable, but usually purplish or grayish. Purple seems to be the natural colour, although, when very young, it is met with cream-coloured, or even white."

Now, we need hardly inform our readers that there exists such a work as Professor Forbes's History of the British Star-fishes and their

allies, published nearly twenty years ago, the most hasty perusal of which would have shown Professor Jones the erroneous nature of the several statements embodied in the extracts which we have just quoted. For, in Professor Forbes's work it is most distinctly stated that the true star-fishes constitute not merely a *genus*, but a distinct *order*, termed Asteriadæ, of which order the common cross-fish, by name *Uraster* (= *Asteracanthion*) *rubens*, is the most abundant species; and further, that the genus Asterias of modern zoologists contains but a single British species, *A. aurantiacea*, commonly known as the Butthorn. Again, the northern sea-star, *U. glacialis*, a species quite distinct from *U. rubens*, is said to reach the length of thirty-three inches, a statement which, from our own personal observations, we are enabled fully to confirm. Moreover, the usual colour of this species is not purplish or grayish, as Professor Jones informs us, but inclines rather to a pale reddish or orange brown.

The entire work abounds with loose and inaccurate statements, similar to the preceding, which it is not necessary that we should notice in detail.

The plagiarisms of our author are frequent, and in some cases are so evident as to render the detection of the source whence they have been derived a task of but little difficulty. His work abounds also with quotations, which, on more than one occasion, he neglects to acknowledge. The account of *Cydippe pomiformis* is a miserable imitation of the graphic and beautiful description of this Ciliograde given by Mr. Patterson in his well known "Zoology for Schools." Several long extracts are taken from the works of the late Sir J. G. Dalyell, whose voluminous writings have been to Professor Jones an ample storehouse of facts, from whence he might at all times draw when other sources failed. Nevertheless, original passages now and then occur, from the perusal of which we may gather the mode in which the personal researches of Professor Jones were carried on, and the results which he thereby attained. Thus, on one occasion, he lost himself on a dark night upon the Yorkshire coast, and was thereby enabled to observe the phosphorescent appearance sometimes assumed by the sea.

Upwards of 750 lines of poetry are contained in the present volume. In many cases we have been unable to ascertain the name of the author from whom these extracts have been taken, and we have, therefore, been led to suspect that perhaps they may have emanated from the pen of Professor Jones himself,—a conjecture which (it has been suggested to us) one of his prænomens would seem to render probable.

We have yet to speak of the illustrations. These are, without doubt, the worst which have ever appeared in any of the numerous publications of Mr. Van Voorst, usually so remarkable for the excellence and originality of the figures which they contain. Indeed, we are at a loss to understand how plates so inferior as the present could ever have been produced by so distinguished an artist as Mr. Tuffen West,—the author, be it remembered, of the excellent lithographs which accompany the "Micrographic Dictionary" of Griffith and Henfrey, the "British Diatomaceæ" of Smith, and the "Fresh-water Polyzoa" of Allman. Many of the

figures in Professor Jones's book are reduced copies of those which occur in the works of Sir J. G. Dalyell, whilst others are so disfigured as to render the recognition of the source whence they have been obtained a matter of considerable difficulty. Thus, in Plate I., the artist, intending to represent *Stomobrachium octocostatum*, has introduced in its stead an incorrect figure of what appears to be *Thaumantias lucifera*. In both of these Medusæ the reproductive glands are of a yellow tint, but in the figure to which we have referred these organs are painted of a brilliant scarlet. Few would recognise as *Aplysia depilans* the strangely coloured monster represented in Plate VIII., where also, under the name of Buccinum, may be found a hideous illustration of what is probably *Fusus corneus*.

A brief dissertation on the importance of becoming acquainted with the facts of science, and the danger of indulging in speculative opinions, forms a not inappropriate conclusion to Professor Jones's Manual, which is dedicated to the Members of the London Institution, and left to the merciful consideration of his lady friends.

THE STUDENT'S MANUAL OF GEOLOGY. By J. BEETE JUKES, M. A., F. R. S., &c. &c. Edinburgh: Adam and Charles Black. 1857.

THIS book was originally designed, as the author informs us, to have been written by himself and the late Professor Forbes; and in consequence of his death, the entire task devolved upon Mr. Jukes alone.

The design of the work is excellent, consisting of three parts—Geognosy, Palæontology, and Geology proper, or history of the surface of the globe. The science of Geognosy is divided by Mr. Jukes into two branches—Lithology and Petrology (or *Petralogy*). By Lithology Mr. Jukes understands all that relates to the mineral structure of rocks; and by Petrology, all that relates to the structure, in a mechanical sense, and arrangement of rock masses.

The Manual is, on the whole, a valuable addition to our list of geological text-books, and we are certain that the author will not be displeased at our pointing out some minor blemishes, the removal of which in a future edition will add greatly to the value of the work. He has, with more honesty than prudence, published a formidable list of *Errata et Corrigenda*, with the following preface:—

"My excuse for the number of the following corrections must be the circumstances under which the book has been written and the proof-sheets corrected: at odd times, namely, in the intervals of other occupations, on wet days in country inns, in railway carriages, in remote parts of the country, where I could not refer to the rest of what I had written, and while so engaged in other matters that I could not recollect it. I only discovered many of those noticed while preparing the Indexes, and fear some others may still remain, which have escaped my attention.—AUTHOR."

Whatever be the reality, it is unwise in an author to confess haste, or want of time, in the preparation of a book; as it is not polite to the reader to be told that the odds and ends of the author's time are good enough for him. As has been remarked by one well acquainted with human nature:—"Confusion and perplexity in writing is, indeed, without excuse, because any one may, if he pleases, know whether he understands and sees through what he is about; and it is unpardonable for a man to lay his thoughts before others, when he is conscious that he himself does not know whereabouts he is, or how the matter before him stands. It is coming abroad in disorder, which he ought to be dissatisfied to find himself in at home."

In treating of Lithology, Mr. Jukes has committed, as we think, a serious error of judgment in writing the formula for silica, $Si\,O_2$, instead of $Si\,O_3$. Every chemist knows that it is a matter of taste which formula be adopted, and therefore the almost universal rule of using Berzelius's formula should not be lightly departed from. It is used by all English and American mineralogists, with the exception of Nicol; by all French and Swedish writers; and by all the more eminent of the German school—Rammelsberg, Rose, and others. Under these circumstances, Mr. Jukes was not warranted in adopting in a Student's Manual a new-fashioned nomenclature, which is confessedly on its trial. In one respect he has adopted an important principle, in discussing the relative quantities of oxygen in the acid and bases of the minerals, including the peroxides as well as the protoxides. Mr. Jukes, however, could hardly have been aware that this principle is one in daily use in every laboratory, and that what are called mineralogical formulæ (as distinguished from chemical formulæ of minerals) are founded on this well-known principle, and used by the whole French school of mineralogists; or he would not have attributed its discovery to his friend, Professor Sullivan, who, we are certain, must have been equally surprised as ourselves at the following passage in the preface:—

"In selecting the minerals for description, I wished to limit myself to those which are rock-constituents either commonly or occasionally. Dr. Sullivan also examined these descriptions for me, and pointed out a certain relation which might be traced in them, between the proportions of oxygen in the acid to that in the base, by means of which relation the close connexion between allied minerals is made more obvious, and placed on a more systematic basis than hitherto. This relation is indicated by the expression, 'O in a : O in b,' in the line which Dr. Sullivan has added to each of the minerals. It will be, I believe, of interest and importance to the chemical mineralogist. By means of it the essential connexion, for instance, between Labradorite and Comptonite, and between Orthoclase or Albite and Stilbite, and the fact that the Zeolite is merely a hydrated form of the feldspar, is made remarkably prominent."

Mr. Jukes might with equal justice have assigned to his friend the invention of the Rule of Three. On the whole, the lithological part of the book is well and clearly written, and will prove of great service to the student, who can interpret the chemical formulæ with ease. In the classification of rocks of igneous origin, the authorities followed are Daubeny, Cotta, and D'Archiac. In page 62, Professor Bunsen's attrac-

tive theory of igneous rocks is given briefly, and is worthy of attention, as it appears to be gaining ground among Continental thinkers. On the delicate subject of Metamorphism Mr. Jukes's views are sound, and of the English school; and he attributes the principal share of metamorphic action to the transforming agency of the igneous rocks, illustrating this action from the well-known examples of the slate rocks of Wicklow and Wexford:—

"While we give full allowance to the importance and magnitude of the metamorphic effects produced by water at whatever temperature, there are yet still greater and more general changes which we must believe can only have been effected by the action of heat, too great to allow of the presence of water.

"When we see whole mountain ranges, and whole districts of country, consisting of rocks that have more or less analogy in structure and constitution to rocks known to be of igneous origin, we cannot help feeling convinced that igneous action must in some way have been concerned in their production.

"When we find that these rocks have every gradation, from such as might have been once molten, into rock which we know to have been mechanically deposited under water, we are compelled to conclude with Lyell that these rocks are altered or metamorphosed by heat from their original aqueous and mechanical formation into a state more or less nearly approaching true igneous rocks.

"Our belief in the truth of this metamorphism becomes certainty when we see these rocks always occurring on the flanks of masses of granite, and examine a district (such as Wicklow and Wexford) where both large and small masses of granite appear, and find these metamorphic rocks, not only always accompanying the granite, but occurring *nowhere else* except in the neighbourhood of granite or granitic rocks, and their extent always proportioned to the size and extent of the particular granite mass they mantle round.

"It is by no means intended to assert that the neighbourhood of granite or igneous rock is the only source of heat from which this metamorphosis can arise. Should any mass of rock, capable of alteration, be so deeply buried in the earth as to be brought within the reach of any centre of heat whatever, the same effect would result; and it is quite possible that a far greater intensity and wider range of heat may be thus reached than could proceed from the mere intrusion of a more or less isolated mass of igneous matter into spaces which were naturally of a lower temperature. But as an intrusive mass of granite must be a source of great heat, and as the metamorphic effects in question are found always to accompany it, we are obliged to look upon heat as the cause of the effect.

"This effect of intense heat may doubtless be variously modified by the previous presence or absence of water, and by the various mixtures of mineral matters occurring in the different rocks before alteration."

Mr. Jukes should not, holding, as he does, such correct views on the subject of metamorphism, have elsewhere quoted Bischof's wild speculations on the same subject, without some caution to put the student on his guard against his theory, which has been well described by saying, that, according to Bischof, the end of all things is mica.

In the Petralogical portion of the Manual Mr. Jukes is quite at home, and we know of no text-book in which so much useful and practical information on this branch of geology is given. It is the most original portion of the work, and is the only part of it that is illustrated. The woodcuts themselves are well intended, but badly executed, and coarse, and occasionally printed upside down. The author has good cause to complain of the printers and readers who revised his sheets.

We are glad to find that Mr. Jukes, who, from his large experience as a geological surveyor, is well qualified to judge of such a question,

lays great stress on the lithological character of particular beds, which, on other grounds, are known to constitute important geological horizons.

"The extent of single beds is most certainly ascertained in coal mining, in which the horizontal (or lateral) extension of beds is followed. Particular beds of coal, or of shale, or other rock having remarkable and recognisable characters, are sometimes known to spread throughout a whole district. For instance, in South Staffordshire a bed of smooth black shale, a little below the thick or ten-yard coal, is known as the 'table batt.' It has a thickness of from two to four feet, and extends over all the greater portion of the South Staffordshire coal-field—places where it is known being ten or twelve miles apart from each other in straight lines and in different directions. Its original extension was probably much greater, since the beds now disappear in one direction by 'cropping out,' and are buried in others at too great a depth to be followed. Known beds of coal, with a particular designation, such as 'Heathen coal,' extend over still wider areas, and similar facts occur abundantly in most coal-fields.

"Neither is the great extension of single beds confined to those containing coal, but is found wherever there are beds of a sufficiently remarkable character to be noticed and recognised. A little bed called the bone bed, from its containing peculiar fragments of fossil bones, which lies just at the top of the New Red Sandstone of the south of England, is found both at Axmouth in Devonshire, and at Westbury and Aust in Gloucestershire—places full sixty miles apart—the bed itself never being more than two or three feet thick, and frequently only as many inches. It is even stated by Mr. Strickland, that he has identified this same bed in the form of a white micaceous sandstone up to Defford, in Worcestershire, 104 miles from Axmouth, and at Golden Cliff and St. Hilary in Glamorganshire.—'Proceedings of the Geological Society of London,' vol. iii. pp. 585 and 732. Similarly, a bone bed at the junction of the Ludlow rock and Old Red Sandstone, never more than a foot thick, and frequently only one or two inches, has been traced at intervals over a space of forty-five miles from Pyrton Passage to the banks of the Teme near Ludlow.

"Whether these beds be absolutely continuous or not over all the intervening spaces, these facts are sufficient to prove the uniformity of conditions over very large areas, so that wherever deposition took place, it was of precisely the same character. In the case of the bone beds mentioned above, the conditions under which they were deposited seem to have been so very peculiar that they may perhaps be looked upon as exceptions rather than as examples of a rule. It is useful, however, sometimes to know what is possible as well us what commonly occurs; neither, probably, would they be very uncommon if single beds were more frequently capable of being traced.

"When from a single thin bed we come to the examination of a group of a few beds, the instances of mineral identity over very wide areas become still more frequent. This is especially observable when the group of beds is of a character quite different from the larger mass of rocks in which they lie; provided that difference points to a state of greater tranquillity or quietness of action, as would a bed of clay occurring in a group of sandstone beds, or a bed of limestone or coal occurring in others having a purely mechanical origin. We may take, as an example, what is called the Bala limestone in North Wales. This is a little group of a few beds, rarely exceeding twenty feet in thickness. The lowest bed is generally a black crystalline limestone, over which are several beds of hard crystalline concretionary and nodular limestone of a gray colour, alternating with more shaly or slaty beds. These contain small black nodules, possibly of a coprolitic origin.* The softer argillaceous bands wear away more rapidly than the crystalline layers, which accordingly stand out in relief like a cornice moulding. By these characters the Bala limestone may often be perceived at the distance of half a mile on the side of a hill, and distinguished from the rocks of hard gritty slate above and below it. It extends from near Dinas Mowddwy on the south, to Cader Dinmael, on the north, a dis-

* "By 'coprolitic' is meant that they were the 'droppings' of fish or other animals."

tance of 22 miles, and from near Llanrhaidr yn Mochnant, on the east, to the valley of Penmachno on the west, a distance of 24 miles; thus occupying an area of 400 or 500 square miles at least. It probably was once much more extensive; because, though we reach its apparent original termination in one direction near Dinas Mowddwy, where it dwindles to a thickness of two or three feet, in others its present 'outcrop' shows no symptom of diminution of thickness or other sign of original termination."

On the subject of joints we must allow Mr. Jukes to speak for himself, premising that, in our opinion, the "strike joints" of Sedgwick are really cleavage planes, and that the threefold principal joints in granite are due to crystalline, and not to polar or mechanical forces. We would except from this remark joint faces occurring in gneissose granite, as such faces are unquestionably due to mechanical pressure, and are a form of cleavage; they may be well studied in the granites of Donegal and Scotland:—

"For the production of natural blocks of rock there must clearly be, *at least*, two sets of joints in stratified, and three sets in unstratified rocks, each set more or less nearly at right angles to each other.

"If we compare a set of stratified rocks to a pile of slices of bread, it is clear that to divide these into lumps, we must cut them in two ways, lengthwise and across. The unstratified rocks, however, would resemble the whole loaf, which we must cut at least in three directions in order to divide it into lumps, first horizontally into slices, and then lengthwise and across.

"In addition to these fewest possible sets of joints in the two kinds of rock, there are in reality others in various and irregular directions.

"If we pause here to inquire as to the general cause of joints, the only answer we can give is, that they are, in the first place, the natural result of the shrinkage or contraction of rocks upon consolidation.

"In examining the newly formed beds of stone in the small islands upon coral reefs, they are always found to be divided by joints like other rocks. The consolidation of this stone was obviously due to the action of rain-water dissolving part of the carbonate of lime, and redepositing it as a cement, so as to bind together the previously incoherent coral sand; for the stone generally rested on and was surrounded by coral sand still incoherent. Among the coral islands on the north-east coast of Australia I often observed several beds of stone resting on each other, each more than a foot thick, inclined at an angle of 8° or 10°; that is to say, at the same angle as the slope of the beach or bank of sand on which they rested. They had to all appearance been formed, that is, consolidated, in this position. The points which traversed them, although often uneven and jagged, ran in straight parallel lines over spaces sometimes of 200 yards, or as far as they could be seen, their planes being generally at right angles to those of the beds, one set of joints running along the greatest linear extension of the mass ('strike' joints), and the other set directly across the former, and in the same direction as the inclination of the mass ('dip' joints).

"The directions of these two sets of joints seemed to depend in these cases on the *directions of the principal bounding surfaces or edges of the mass.*

"Professor Phillips tried many years ago, in his Geology of Yorkshire, whether the directions of the principal joints were not related in some way to the magnetic meridian, and arrived at results showing a tendency in the two principal sets of the joints of the Yorkshire rocks to arrange themselves according to certain magnetic bearings. This, however, seems to be only another way of stating that there are two principal sets of joints in the district, those of each set being parallel to each other.

"Professor Sedgwick refers the directions of joints chiefly to the lines of upheaval and disturbance in rocks, calling those which run along or parallel to the 'strike' of the beds, 'strike joints,' and those parallel to the 'dip,' 'dip joints.' All other joints he calls 'diagonal' joints.

"These are useful terms, whether the two things be or be not related in the way of cause and effect.

"It is certain that some joints have been produced in all rocks anteriorly to, and independently of, the action of the forces of upheaval which have elevated them; but it is very likely that the direction of the lines of upheaval may have been governed or modified by that of the principal joints, and that other joints may have been the result of the action of these disturbing forces."

One of the best sections in the book is that on Faults; but it is so dependent on its illustrations that it is useless to quote from it, and we must refer the reader to the book itself. The coal-miner's rule is well expressed by Mr. Jukes:—

"In speaking of the inclination of a fault, it is better not to use the term 'dip,' as if it were a bed, but to adopt that of 'hade' or 'underlie.' In inclined faults, and it almost always happens that faults are inclined, there is one nearly invariable rule, which is, *that the fault 'hades' or 'underlies' in the direction of the downthrow.*

"As a corollary of this rule also, another equally important one may be stated, namely, that however inclined may be the fault, *no part of any bed will ever be brought vertically under another part of it*, and therefore superior beds can never be brought *by any* fault under those originally below them.

"Small exceptions to these rules may sometimes occur in rare instances; when they do, the fault that produces them is called a *reversed fault.*"

With respect to "Reversed Faults," the author is of opinion that they are always minor faults, and exceptions to the general rule of the same district. In this opinion we fully concur:—

"Professor H. D. Rogers, in his paper on the 'Laws of Structure of the more disturbed Zones of the Earth's Crust,' 'Trans. Royal Soc., Edin.,' vol. xxi. p. 3, in describing faults along the axes of anticlinal curves, where inversion has taken place on one side of the anticlinal, speaks of the uninverted part of the anticlinal having been thrust up the inclined plane of the fault, over some of the inverted beds, as in Fig. 51.

"Professor Rogers does not allude to the fact of this form producing a *reversed* fault, nor is it quite clear in his paper whether the structure thus described has been absolutely observed in sections, or is merely introduced hypothetically as an explanation of certain puzzling phenomena. If actually observed, a detailed description of the locality would be very interesting, neither am I prepared to combat the hypothesis, if it be one, since it is just in such greatly disturbed districts that 'reversed' faults are likely to occur.

"Another published example of a reversed fault on a large scale is given in the Rev. Professor Haughton's paper on the 'Mining District of Kenmare.'—'Journal, Geological Society, Dublin,' vol. vi. In this case, also, no notice is taken of the fault, as drawn, being a 'reversed' one; and though it is in a highly disturbed district, and running parallel to the axis of a synclinal curve, yet, as its plane does not coincide with that axis, but cuts across it obliquely, and buries some of the upper rock under the lower in a very peculiar manner, it appears to me a far less probable form of fault than that described by Professor Rogers."

Professor Haughton has recently published another example of reversed fault on an oblique anticlinal axis, together with a general theory of such phenomena ("Nat. Hist. Rev.," vol. v., Proceedings of Societies, p. 164, and Plate XX.); but we do not know whether he is prepared to defend the reversed fault at Kenmare adverted to by Mr. Jukes.

In the section on Cleavage the mechanical theory is advocated, and many important facts connected with the subject stated:—

"One of the most striking effects of cleavage is the distortion it produces on fossils or other small bodies embedded in the rocks, lengthening and pulling them, as it were, in the direction of the cleavage, and contracting them in the opposite direction. Relying on these facts, which were first distinctly noticed by Professor John Phillips, Mr. Sharpe attributed the production of cleavage to the action of great forces of compression squeezing the particles of rock in one direction, and lengthening them in the opposite.—'Quarterly Journal, Geological Society,' vol. iii. p. 87. Mr. Darwin, also, from his observations in South America, formed similar ideas as to the origin of cleavage, and speaks of cleavage planes as being probably parts of great curves, of such large radius as that any portions of them that can be seen at one view appear to be straight. More recently, Mr. Sorby resting on the fact of beds of sandstone which occur in slate being contorted, and their dimensions being contracted at the sides, and expanded at the tops and bottoms of the curves, the axes of which curves coincide in direction with the cleavage planes, while the beds of slate above the sandstone are little or at all bent, shows that the particles of the slates must have been compressed at right angles to the cleavage planes, and lengthened along them, so as to allow of their being squeezed into the same contracted space as the sandstones, without much bending of the surfaces of the beds.—See 'New Philosophical Journal, 1853,' vol. iv. p. 137; or Lyell's Manual, 5th edition, p. 611.

"By microscopical examination, Mr. Sorby found that the minute particles of clay-slate were either lengthened in the direction of the cleavage planes, or that those minute particles which were of unequal dimensions were so re-arranged as that their longer dimensions coincided with the planes of the cleavage.

"Professor Sedgwick at one time thought that he could perceive a tendency to a symmetrical arrangement of the inclination of the planes of cleavage with respect to the axes of lines of elevation, the dip of the cleavage being inwards on each side of the mountain ranges. He afterwards, however, saw reason to abandon this conclusion. Mr. Darwin speaks of the fan-like arrangements of the cleavage planes which have been described by Von Buch, Studer, and others; and Mr. Sharpe says that this apparent fan-like arrangement is due to parts of two contiguous curves meeting where their adjacent sides become perpendicular. But we must refer the reader to his paper on this subject, in the third and fifth volumes of the Journal of the Geological Society before quoted, and in the Philosophical Transactions for 1852. A second cleavage plane cutting across the first at right angles, and also across the bedding, is described by Mr. Sharpe in his second paper on Cleavage in the Geological Journal, vol. v. p. 3, and was also long before observed and mentioned by Professors Sedgwick, Phillips, and others. Mr. Sharpe attributes this likewise to compression.

"The subject has recently been investigated by Professor Tyndal, who, in a paper in the Philosophical Magazine, vol. xii., distinctly refers the origin of cleavage to the same force of compression, acting at right angles to the cleavage planes, that Mr. Sorby and Mr. Sharpe had referred it. Professor Haughton, in a paper in the same volume, has deduced mathematically a value for the compression of the rocks, from examining the amount of distortion suffered by fossils in some particular instances in consequence of this compression.

"There seems indeed now little doubt that mechanical compression is the true cause of cleavage; but the whole subject requires still more accurate and detailed observations than have have yet been made on it. I have seen reason to suspect—in some districts of North Wales, for instance—that subsequent movements and dislocations have affected large cleaved districts in such a way as may have altered both the dip and strike of the cleavage from their original position. Direct observation then, now, will only lead us astray, unless it be corrected by a more accurate knowledge than we yet possess of the amount and direction of these dislocations, and of their relative age compared with that of the cleavage. The tip of the cleavage especially is very easily mistaken, unless it be observed in very clear and deep excavations. Superficial causes have frequently affected, and sometimes completely reversed it to very considerable depths, as may be seen in Fig. 58.

"When these superficial bendings of slate occur on steeply inclined ground, they may perhaps be referred to the action of gravitation on substances loosened by weathering, or the 'weight of the hill,' as it has been called. In other cases their origin is more obscure, and I have seen one instance in North Wales, where, on the horizontal surface of an isolated boss of rock, the slates were so sharply and abruptly bent back and laid nearly flat, and partly consolidated in that position, as to give the idea of its being due to some sudden and great force, such as the grounding of an iceberg.

"Thoroughly to work out the subject of the 'cleavage' of any district would require months of continuous and laborious observation in a country, the geological structure of which had in other respects been thoroughly and accurately surveyed; and with the exception, perhaps, of North Wales, no country has yet been surveyed with anything like an approach to such accuracy.

"It must be recollected that it is one thing to arrive at a conclusion as to the cause of cleavage, and the laws of its production, and another to ascertain those laws or general rules of occurrence of cleavage planes in nature. The first may be done in the closet, or the museum, as has been done by Sorby, Tyndal, and Haughton, but the latter can only be done by the field surveyor, and that *after* and not contemporaneously with the general survey of the country."

We extract the section on the relations between Felstone and Greenstone whole, on account of the interest of the view it opens up, and also because it is one in which we are not fully prepared to coincide. The question is fully discussed in a remarkable paper by M. Durocher, a translation of part of which is published in the present Number of our Review.

"I have occasionally been struck in some of the districts just alluded to, with the association of felstone and greenstone, it being rare to find any considerable mountain mass of felstone without irregular patches of crystalline greenstone disseminated about it. The irregular outline of these greenstone patches gave them the appearance of being subsequently intrusive into the felstone, but the frequent association of the two has sometimes led me to speculate on the possibility of the two rocks having been part of the same molten mass, and having settled or segregated apart from each other on the cooling of the whole. There seems no very cogent reason why we should necessarily suppose the whole molten mass to have been completely homogeneous; but granting that it was so, is it not possible that, when a deep-seated mass of trap commences to cool, a separation may take place, and one more fusible portion of it may be segregated from the rest, and thus one or more local centres might be established, into which the greater portion of the more fusible bases (silicates of lime and iron) should be concentrated? These local patches, which, on the ultimate complete refrigeration of the whole, would form greenstone, while the rest of the mass was felstone, or elvanite (quartziferous porphyry), as the case may be, *might* retain their fluidity for a time, till, on the consolidation and consequent contraction of the other mass, they were squeezed in various directions into the cracks and fissures that would then be caused, and then cool rapidly in consequence of their greater extent of surface."

Again, we find, at page 293, the following remarks, with which we only concur in part:—

"If we assume all igneous rocks to proceed either from one central molten mass of equable constitution throughout, or from separately fused portions of perfectly similar constitution, might we not suppose that the difference in the constitution of the various products which we find at the surface depended on the circumstances and conditions in which they had been placed? The portions now open to our examination had probably to pass through different thicknesses and different kinds of other rocks; they would be placed then under different conditions of temperature and pressure, which might perhaps alone cause a separation to take place in their different ingredients; they might also take up in their

passage other ingredients of different character from those which they originally possessed, or larger proportions of one or other of their original ingredients. In those places or at those times when violent accessions of heat approached most nearly to the surface, trachytes and felstones might be poured out, while at other periods of less intensity no molten rock could reach the surface unless it were composed of more easily fusible minerals. These more readily fusible substances might be conceived either to have separated in liquid strings and veins from the consolidating rocks below, or to have been acquired by the upper portion of the mass from the rocks it met with in its passage towards the surface, the substances thus added having acted as an additional flux to matter which would otherwise have solidified before it could have been poured out."

The second and third parts of this book do not appear to us to be so well adapted to the student's wants as the first part on Geognosy. They treat of Palæontology and Geology proper; and discuss the subject of fossils biologically and historically. The student will complain of the absence of all illustrations; and we think that Mr. Jukes would have better consulted his readers' wants if he had confined his attention to characteristic fossils, and given a general and masterly account of the history of organic life on the globe, and of its distribution over its surface. He has allowed himself, as we think, to be carried away too much with the details of his subject, and has thus given the appearance of a mere catalogue of names to the most interesting branch of Geology. The learner, using Mr. Jukes's book, must find out for himself that this portion of it is intended to be referred to, and not read; and should he, unfortunately, like ourselves, spend an evening or two in its serious perusal, he will, most likely, suffer from a palæontological nightmare, in which Pictet, Jukes, and Morris, will have a large share; or should he lie awake, he must experience sensations similar to those of a student who has rashly attempted to read the catalogue of the ships in the second book of Homer.

These two parts of the book should check each other, like book-keeping by double entry; as the fossils are entered in the first part zoologically, and in the second part, chronologically. This circumstance would render such lists of great value to the student for reference; but their entire value depends on the accuracy with which this is accomplished.

The following is Mr. Jukes's preface to the work of tabulating the fossils zoologically:—

"I have determined to lay before the student in this chapter a classified catalogue of fossil animals and plants, in order, first, to give him an idea of the richness and extent of the domain of palæontology, and, secondly, to furnish him with a reference as to the nature of any particular fossil he may find mentioned in this or other works, and also to place before him the main facts of the distribution of fossils in time. This latter subject will anticipate somewhat that which properly belongs to the third part of this work, but its utility will countervail, I hope, any breach of logical sequence.

"I have taken Pictet's Palæontology as my guide with respect to fossil animals, having merely re-arranged or transposed some of the matter to make it suit the classification previously given a little more closely.

"I have not, however, attempted to do this throughout, and the student will take any variation in the two classifications as a hint that systems, however necessary, are, after all, more or less arbitrary and imperfect, representing often rather the limited powers of

the human mind than the infinite variety and superabundance of nature. I have also ventured so far to disturb Pictet's arrangement as to place the extinct genera of each family or order by themselves, preferring to mark their geological history more strongly than their zoological relations.

"For the plants, I have only given an abstract of those mentioned in Bronn's Index Palæontologicus, with very few additions."

Mr. Jukes defines a fossil as "the body, or any portion of the body, of an animal or plant buried in the earth by natural causes, or any recognisable impression or trace of such a body, or part of a body:" a definition precisely similar to that laid down several years since by Sir Charles Lyell in his "Elementary Manual of Geology." After a few remarks on the nature of "petrifaction," Mr. Jukes, as a necessary introduction to the right comprehension of the facts of Palæontology, presents his readers with classificatory tables of the two great kingdoms of the organic world. His classification of the animal kingdom (with the exception of that of the Mammalia, in which he follows the arrangement of Professor Owen) has been supplied to him, we are informed, by his friend, Professor Huxley. But though the system here given corresponds with that adopted by the eminent naturalist whose name we have just mentioned, in some particulars—such, for example, as the recognition of the Protozoa and Cœlenterata as distinct sub-kingdoms, and in regarding the Echinodermata as a class of the Annulosa—yet in other respects it is widely different; and we are of opinion that some error must have been committed by Mr. Jukes in interpreting the views of his distinguished colleague. Thus we are told that the Hydrozoa are divided into two orders only—Lucernaroida and Hydroida; whereas we have always understood that Professor Huxley considered this class as consisting of several orders, certainly of not less than five. Again, on the same authority, the Rugosa are separated from the Zoantharia of Milne-Edwards, and regarded as a distinct order in themselves; whereas, in the published Lectures of Professor Huxley they are plainly stated to constitute a subdivision of the Alcyonaria. The true position of this interesting group of corals is certainly well worthy of consideration, and we would fain digress awhile from our subject to dwell on a topic so important, more especially since Professor Agassiz, in a letter to Dana, the distinguished American zoophytologist, has recently given it as his opinion that not only they, but likewise all the Tabulata, including the Milleporidæ, Favositidæ, Seriatoporidæ, and Thecidæ, should be removed from the class Actinozoa, and transferred to the Hydroid division of the Cœlenterata sub-kingdom ("Silliman's Journal," July, 1858).

To return, however, to Mr. Jukes's Manual. After briefly noticing the general laws of distribution, he commences the subject of Palæontology proper by presenting us with a long "Abstract of Fossil Genera," occupying somewhat more than fifty pages. In this "Abstract" Mr. Jukes very properly arranges the different genera enumerated under their respective families, orders, and classes; whilst after the name of each genus he has appended initial letters indicative of the geological formation to which it belongs,—such as D. for Devonian, S. for Silurian,

&c. Were a Table of this kind drawn up with the care, patience, and constant exercise of judgment necessary for its preparation, the results so obtained would be invaluable to the student of Palæontology, who would find it a complete abstract of the existing state of our knowledge of the distribution of organized beings in time. And such an abstract, there can be little doubt, the present Table would have been, had not death deprived Mr. Jukes of the assistance of one whose time and genius had alike been devoted to the consideration of the relations which the members of the organic world bear to one another, and to the external conditions in which they are placed; and whose well-known Essay on the "Distribution of the Plants and Animals of the British Islands" has been justly characterized by an eminent authority as "the most important contribution to the philosophy of distribution that has ever appeared." It is otherwise, however, with his surviving colleague. In the first portion of Mr. Jukes's work we have seen him wield his pen, not without success, in the discussion of doctrines with which he had long been familiar, and in the treatment of details many of which he could amply corroborate from the results of his own extended personal experience. But when he comes to speak of Palæontology, he adopts a course the reverse of the preceding: laying aside his pen, like the editors of certain newspapers, he takes up the scissors in its stead. The palæontological portion of his work consists, in short, of little else than a judicious selection of neatly clipped fragments from the voluminous treatise of Pictet, interspersed with occasional derivations from the writings of other eminent authorities. To the naked eye the aspect presented by the last 250 pages of his work is exceedingly repulsive, closely resembling that of a vast dictionary, containing several thousand long Latin names, the mere endeavour to spell which would be in itself no ordinary task. Upon more minute examination, several errors and inaccuracies may be detected, appearing conspicuously amid this cumbrous mass, of which the following may be noticed as a sample of the rest:—In the "Abstract of Fossil Genera" we are told that the genus Dendropora is characteristic of the Devonian formation; whereas, on turning to another portion of the work, we find it stated that it takes its rise in, and does not survive, the Carboniferous period. At page 370 the author enters into a vehement protest against the "cumbrous" nomenclature of Milne-Edwards and Haime, and strongly objects to their system of affixing the same termination to several allied genera—e. g., Isastræa, Thamnastra, &c.; whereas he himself, by the adoption of a number of false genera not admitted by these zoologists, has incumbered the subject with many unnecessary difficulties. The Table at page 382, showing the comparative number of the living and fossil species of the British islands, in the compilation of which the author has been assisted by his colleague, Dr. Kinahan, is drawn up in a hasty and inconsiderate manner. So numerous, in short, are the errors contained in the Palæontological Tables of Mr. Jukes, that it would seem as if, through a desire to direct the attention of the student to his own more favourite branch of the subject, namely, Physical Geology, he had endeavoured to render the palæontological portion of it as disagreeable as possible.

But let us not be misunderstood. We have noticed these faults lest any of our readers, impressed with the real merit of a considerable portion of Mr. Jukes's work, should too hastily adopt all the statements which it contains: and we are far from wishing to detract in any way from the fame of an author who is justly entitled to a high place in the ranks of British geologists.

Physical Geography. By Mary Somerville. Fourth Edition, thoroughly revised, with a Portrait. London: John Murray. 1858.

In this volume we have the fourth edition of Mrs. Somerville's "Physical Geography," with a portrait of the authoress, and many additions contributed by her scientific friends.

In a work of this kind originality of thought is not to be expected, and it has fallen to the lot of a lady to have written the most popular work in English on Physical Geography, as well as on the connexion of the Physical Sciences. The female mind is, perhaps, better suited than that of man for such compilations, as the habits of the sex render them more familiar with the scissors than can be expected of their rougher brothers in literature. Whatever the reason be, we must confess that we always found Mrs. Somerville's books heavy reading: they are too condensed, too instructive, and resemble a Christmas pudding into which the zealous housekeeper has put too much raisins, currants, and citron. This, however, is a matter of taste, and we are well aware that many persons, better judges than ourselves, think differently, or at least say so; for it must be admitted to be a peculiarity of Mrs. Somerville's position, that, owing to the deference due to her sex, she is not likely to hear the whole truth respecting either her books or scientific attainments from those with whom she associates. She has herself, also, fallen somewhat into the British Association style of speaking of all persons who have either written a book or read a paper, as "able," "admirable," "highly original," &c.—terms which are now beginning to be estimated at their true worth, even by the lookers-on. For example, in the Preface to the present work we find the following:—"Humboldt's invaluable Cosmos," "Sabine's excellent notes," "Sir Charles Lyell, wherever the English language is read or spoken," "Sir Roderick Murchison, unrivalled in everything connected with geology," "the able direction of Colonel Waugh;" and the equally "able Survey of Mr. Gregory," and last, and, certainly, not least in his own opinion, "her great authority and guide," the Master of Trinity.

Such conventionalities and courtesies smack of the conversazione or Red Lion Club too much to suit our taste; but with an authoress, we presume, they are indispensable.

The following is a fair specimen of Mrs. Somerville's style, and will, we believe, be considered by most readers who are not possessed of Arctic maps, or who have not previously studied them, to be a somewhat uninteresting description of the curious discoveries made by the searching parties who have been seeking the "Erebus" and "Terror" for many years :—

"The continent of North America seems to have been much shattered and broken up by the Polar Ocean into a vast number of fragments of great size, all bearing more or less the severe character of Arctic lands. It may be that the land is sinking down or rising up, for in either case appearances would be the same; but the climate would improve in the first, and would be, if possible, more rigorous in the second. Immediately to the north of the continent land of great extent lies between the 69° and 75° N. lat., and stretching nearly from the 60th to the 125th degree of west longitude. On the south, this mass of land is separated from the continent by various narrow straits, Dolphin, and Union, and Dease Straits. The Arctic Ocean bounds it on the west; the Straits of Banks, Melville, and Barrow, with Lancaster Sound on the north; and its eastern limits are Davis Strait and Hudson Bay. It is divided into three parts by Prince Regent Inlet and the Gulf of Boothia on the one hand, and by Prince of Wales' Strait on the other. The eastern part, known as Cockburn Island, is intersected by various arms of the sea, respecting which little is known. The middle part contains Boothia, Victoria, Wollaston, and Prince Albert Lands. Banks' Island is the westerly continuation; its northern coast was discovered by Sir Edward Parry, who gave it the name of Banks; and Captain M'Clure, in his voyage from Behring Strait, first discovered its most southerly point, Prince of Wales' Strait, which separate it from Prince Albert Land, and afterwards all but circumnavigated the island. Besides these three principal parts, North Somerset Island, lying immediately south of Barrow Strait, forms a northern continuation of Boothia, only separated from it by the narrow passage called Bellot Strait.

"North of that long line of narrow seas or straits, already mentioned, that stretches from Banks' Island to Baffin Bay, lie Prince Patrick, Melville, Byam Martin, Bathurst, and Cornwallis Islands, celebrated in the annals of Arctic discovery as Parry Lands. The two last are now known to be the southern continuation of Queen Land, discovered by Captain Penny. Beyond this is the great oceanic inlet of Wellington Channel, of late years the object of so much Arctic research, and forming its eastern side. The great island of North Devon lies more to the east, and ends in Baffin Bay; on the north it is divided by Jones Sound from North Lincoln, and Ellesmere Island, which is unknown, on the west, but it has been traced as far as Victoria Head in 78° 28′ 21″ N. lat., by Captain Inglefield, who discovered that it is separated from Greenland by Smith Sound, and that the latter is a strait leading from Baffin Bay into the Polar Ocean, an important discovery, confirmed afterwards by Dr. Kane."

In afterwards describing, in more detail, some of the discoveries of the Arctic voyagers, Mrs. Somerville makes some statements which prove that she did not read the narratives she refers to with anything like the degree of care requisite in one who aims at writing a book which may be appealed to as an authority :—

"Dr. Kane, a man of great energy and science, who, by his heroic courage and generous character, was an honour to his country and to the age, left New York with Lieutenant de Haven in the brig Advance, which, as before mentioned, was frozen up for nine months in Baffin Bay in an enormous field of ice. Dr. Kane left the ship with a party, and travelled for 300 miles over the ice, dragging their boats, in which they afterwards made a voyage of 1300 miles to the coast of Greenland. Before they came to the 82° N. lat. they had to pass a barrier of ice from 90 to 100 miles broad. The mean temperature of that icy region was 60° Fahr. (!!) chloroform froze, essential oils became solid, and chloric

ether was congealed for the first time by natural cold; and 57 of the dogs that drew their sledges died. Passing this ice-bound region, they reached the north coast of Greenland, in 82° 30′ N. lat., the land nearest to the pole that had ever been attained. There Dr. Kane stood upon the shores of an iceless sea, extending towards the Pole in an unbroken sheet of water as far as the eye could reach. Its waves were dashing on the beach with the swell of a boundless ocean. Tides ebbed and flowed in it, which certainly did not come from the Atlantic; for at that very time Lieutenant de Haven was making regular observations with an artificial horizon on the ice in which his ship was frozen up, and found the mercury perfectly steady. 'These tides,' observes Lieutenant Maury, 'must have been born in that cold sea, having their cradle at the North Pole, where there must be deep water; for, were this unexplored area mostly land, or shallow water, it could not give birth to regular tides. Seals were sporting and wild fowl feeding in this open sea, the temperature of the water being 36° Fahr., no doubt in consequence of the warm submarine currents from the south.'"

Is it possible that Mrs. Somerville is not aware that Dr. Kane took part in two Expeditions,—one under Lieutenant de Haven, which sailed from New York in May, 1850, consisting of the "Advance" and "Rescue," and the other under Dr. Kane himself, consisting of the "Advance" alone, which sailed in May, 1853? Her statement that "Dr. Kane stood upon the shores of an iceless sea, extending towards the Pole in an unbroken sheet of water as far as the eye could reach," confirms us in our belief that she never read his second book at all, or she would have known that it was Mr. Morton and Hans, and not Dr. Kane, who had the honour of seeing the so-called Polar Sea. The following statement of Dr. Rink, recently read at the Geographical Society, is worthy of Mrs. Somerville's attentive perusal:—

"As regards the second discovery, that of the northern coast of Greenland and the open Polar Sea, it appears that the entire story rests upon the assertions of Morton, the steward, and of Hans, the Greenlander. These two men made a sledge expedition to a distance of three days' journey from camp, but a critical examination into their proceedings during those days leads Dr. Rink to throw great doubt on the value of their observations, as related and mapped out by Dr. Kane. If we are to credit their accuracy, we must be prepared to believe that they laid down more than 20 points of longitude and latitude during their toilsome journey, besides fixing numerous positions on the opposite coast, which Morton maps out in a detailed manner, although he never approached nearer to it than from 25 to 40 miles. Their itinerary is as follows:—The first day's journey takes them beyond the face of Humboldt Glacier to open water, flowing with a strong current; the next day's journey is only six miles; on the third day they have a very rugged way to travel over, and are detained by hunting, killing, and cooking a bear. A high promontory is before them, which they have not strength to reach, and ultimately they stop at the foot of a 'knob,' stated by Morton to be 500 feet high, but upon what grounds it does not appear. He ascends this knob, and from its top professes to obtain a view for thirty-six miles over a sea entirely free from ice; but we are left entirely in the dark as to the extent of the field of view which is left clear by the promontory. Morton sees a mountain to the northward, which he lays down at the enormous distance of 100 miles from the point where he stood, and yet he remarks on the barrenness of its top and on the streaks and ledges upon its face. He sees crowds of waterfowl, and Hans observes some plants, but brings back no specimens, although they are named in scientific phraseology in Kane's work. Dr. Rink joins issue on nearly every one of the data and theories based upon Morton's journey. He considers it out of the question that a man, looking out from an elevation of 500 feet, could determine the absence of floating ice at a distance of thirty-six miles. He also throws great doubt upon the probability of Morton's point of view being as high as he states it to be, for he believes that he identifies it with a hill whose measurement is very variously reckoned by Kane at pp. 299, 305, and 307. He argues that the absence of drift ice tends to prove that the sea was permanently frozen to the northward,

whence the wind was blowing strongly, and that the vast number of birds go to prove the smallness, and not the greatness, of the water at which they congregated; and, finally, that there is nothing remarkable in the discovery of a sheet of open water, in midsummer, only ninety miles to northward of where a ship was sailing the preceding year. The picture in Dr. Kane's work of the open sea, with Morton in the foreground, will not (says Dr. Rink) bear criticism. The sun is represented as half-bathed in the water, although, at that season of the year and latitude, it must be far above the horizon."—*Proc. Royal Geographical Soc. of London*, vol. ii.

The following description of the tides, although not very original, is well written, and conveys a tolerably correct idea of tidal phenomena on the large scale: it is chiefly borrowed from Keith Johnston's "Physical Atlas:"—

"Had the globe been entirely covered with water, the greatest tides would have taken place when the action of the sun and moon was in the plane of the equator and in the same meridian, for then their action would have been most direct; but in that case there would have been very small tides in the high latitudes, and none at the Poles, because then the action of the luminaries would decrease as the square of the cosine of their declination. That, however, is by no means the state of the tides, for, since the action of the sun and moon is only sensible in a vast extent of deep water, the Antarctic Ocean is their source and birth-place. The greatest spring tides, therefore, take place when the luminaries, in conjunction or opposition, are at their greatest southern declination, and the moon in perigee, that is, in the point of her orbit nearest to the earth.

"When the sun and moon, under these circumstances, pass over the ocean to the east of Tasmania, New Zealand, and the South Pole, they raise a vast ridge of water, or great tidal wave, which reaches to the very bottom of the sea, and tends to follow the luminaries to the north-west, and, having received that primitive impulse, it continues to move in that direction long after the sun and moon cease to act upon it.

"On entering the Pacific it flows along the western coast of South America, bringing high water to each place as it passes; but it is so much impeded by the numerous islands in that ocean, that it is scarcely perceptible in many places among them; whereas in the Indian Ocean it rushes with such violence and speed along the shores of the Indian Peninsula, that it arrives at Cape Comorin before noon of the first day of its existence, nearly at the same time that it has brought high water to the coast of Tasmania.

"When this tidal wave enters the Atlantic in its north-westerly course, it brings high water later and later to each place; but its velocity is so very different on the two sides of that ocean, that it arrives at Cape Blanco, on the west coast of Africa, and at Newfoundland, on the east coast of North America, at the end of the first twenty-four hours of its existence. It is then deflected to the east by the Continent of America, and thus flowing at right angles to its former path, it comes to the most westerly points of Ireland and England on the morning of the second day. The great branch of this tidal wave then passes north-east through St. George's Channel and the Irish Sea, and meeting a branch coming round the west coast of Ireland, the united wave, after having carried high water to the west coast of England, and all the coast of Ireland, turns round the most northern point of Scotland, and arrives at Aberdeen at noon on the second day, at the same time carrying high water to the opposite shores of Norway and Denmark. Now, this tidal wave flows to the east of south, a direction exactly contrary to that with which it began its transit through the Atlantic, and it continues this course, ruling the tides along the English shores and those of the opposite continental coasts till it arrives at the mouth of the Thames at midnight of the second day, and does not bring high water to London till the morning of the third day after leaving the Antarctic Ocean.

"The tidal wave moves uniformly and with great velocity in deep water, variably and slow in shallow water. For example, it moves at the rate of 1000 miles an hour in the South Pacific, and scarcely less in the Atlantic, on account of the deep trough which runs through the middle of that ocean; but the sea is so shallow on the British coasts, that the tide takes more time in coming from Aberdeen to London than to travel over an arc of 120°—that is, from 60° S. lat. to 60° N. lat.

"The tide in the open ocean is merely an alternate rise and fall of the water, so that the wave travels, but not the water. A bird resting on the surface is not carried forward as the waves rise and fall; indeed, if so heavy a body as water were to move at the rate of 1000 miles in an hour, it would cause universal destruction, since in the most violent hurricanes the velocity of the wind scarcely exceeds 100 miles in an hour.

"During the passage of the wave in deep water, the particles of the fluid for the moment glide into a new arrangement, and then return to their places; but this motion is extremely limited. In the ocean the resistance of the bottom is imperceptible; but in shallow water, where the velocity of the wave is small, its lower parts are more retarded than those above, and as the friction continually increases with the progress of the wave, its top advances more rapidly than the water below, so that over shallows and near the land both water and waves advance during the flow of the tide, and roll on the beach.

"The height to which the tides rise depends upon the form of the shores and bottom of the sea, and the direction in which the wave strikes the land. Throughout the Atlantic the height is 10 or 12 feet; but the tidal wave rushes so directly into the Bay of Fundy, that it rises to 50 feet, and from the shelving shores in the Bristol Channel it is 40 feet. When the tide enters the North Sea, to the north of Scotland, its height is 12 feet; but in travelling south along the east coast of England over a continually shelving shore, and striking the land always more directly, the water rises higher and higher at each place till in the Humber it attains 20 feet.

"It sometimes happens that two equal tides coming different ways meet, and then the water rises to double the height it would otherwise have done. A complete extinction of the tide takes place when a high water interferes in the same manner with a low water, as in the centre of the North Sea,—a circumstance predicted by theory and confirmed by Captain Hewett, who was not aware that such an interference existed. When two unequal tides in contrary phases meet, the greater overpowers the lesser, and the resulting height is equal to their difference, which is supposed to be the case at Yarmouth, where the tide is very small. These varieties occur chiefly in channels among islands and in the estuaries of rivers. When a tide flows suddenly up a river incumbered with shoals, it checks the descent of the stream; the water spreads over the sands, and a high-crested wave, called a bore, is driven with force up the channel. This occurs in the Hoogly mouth of the Ganges, and in the Amazon at the equinoxes, where, during three successive days, five of these destructive waves, from 12 to 15 feet high, follow one another up the river daily; and it occurs in a less degree in some of our British rivers."

In the chapters immediately following those from which we have just quoted, Mrs. Somerville enters on the discussion of numerous important subjects, which the limited space at our disposal does not permit us to consider. Such, for example, as lakes and rivers, the temperature of the earth, the atmosphere, winds and currents, terrestrial magnetism, &c. We pass on, therefore, to notice those portions of her work which treat of the distribution of organic life over the surface of the globe. In these may be found a vast aggregation of important facts, compiled in most cases from sufficiently authentic sources, but too frequently huddled together in an incongruous and disorderly manner. The botanical chapters contain, perhaps, a smaller proportion of errors than most other parts of the book. The following passage, taken from her account of the Flora of tropical America, may be regarded as an example of Mrs. Somerville's best style, though garnished, it is true, with her usual extensive assortment of adverbs and adjectives:—

"No language can describe the glories of the forests of the Amazon and Brazil, the endless varieties of form, the contrasts of colour and size: there even the largest trees bear brilliant blossoms,—scarlet, purple, blue, rose-colour, and golden yellow are blended with every possible shade of green. Majestic trees, as the *Bombax ceiba* (or silk-cotton tree),

the dark-leaved mora, with its white blossoms, the fig, cashew, and mimosa tribes, which are here of unwonted dimensions, and a thousand other giants of the forest, are contrasted with the graceful palm, the delicate acacia, reeds of 100 feet high, grass of 40, and tree-ferns. Passifloræ and slender creepers twine round the lower plants, while others as thick as cables climb the lofty trees, drop again to the ground, rise anew and stretch from bough to bough, wreathed with their own leaves and flowers, yet intermixed with the vividly-coloured blossoms of the Orchideæ. An impenetrable and everlasting vegetation covers the ground; decay and death are concealed by the exuberance of life; the trees are loaded with parasites while alive—they become masses of living plants when they die. Here, too, occurs the *Siphonia elastica*, that invaluable tree whose juice, known under the name of caoutchouc, has become one of the most important substances in commerce."

The distribution of animal life is less carefully treated of, and the faith of the reader in many of the assertions made by our authoress cannot fail to be shaken by the detection of numerous errors and inconsistencies. Of the eighty-two pages appropriated to the consideration of this division of her subject, nearly thirty are devoted to the mammals alone, twenty to the birds, twelve to the reptiles and amphibians, seven to the insects; while the fishes and marine invertebrata are dismissed in less than fourteen. Yet, it will surely be admitted, that the distribution of the Mollusca, Crustacea, and Echinoderms, is at least as important, in a scientific point of view, as that of any of the more conspicuous animal tribes on which our authoress has enlarged so much; for no other reason, it would seem, than that information respecting them can be obtained with less trouble and difficulty.

Mrs. Somerville divides the Mammalia into nine orders, thereby excluding the Bimana, Insectivora, and Monotremata. The marine Cetacea are said to consist of three *genera*, for which latter term the word *families* should be substituted, in order to render the passage correct. The following passage occurs in the chapter on the distribution of fishes :—

"There are singular analogies between the inhabitants of the sea and land. Many of the Medusæ, two corallines, the Physalia, the Portuguese man-of-war of sailors, sting like a nettle when touched. A cuttlefish at the Cape de Verd Islands changes colour like the chameleon, assuming the tint of the bottom on which it rests. Herrings, pilchards, and many other aquatic animals, are luminous. The Medusæ, or sea-nettle tribe, which are numerous in species, have also the faculty of emitting light in a high degree. In warm climates especially the sea seems to be on fire, and the wake of a ship is like a vivid flame. Probably fish that go below the depths to which the light of the sun penetrates are endowed with this faculty. These luminous creatures are the glow-worms and fire-flies of the ocean, while the fish with great eyes that live in its dark abyss represent its bats and owls. But among terrestrial animals there is nothing analogous to the property of the *Gymnotus electricus* of certain South American lakes, or of the *Silurus electricus* of the African rivers, and the several species of torpedo of the Mediterranean, which possess the faculty of giving an electric shock by means of a very beautiful organic voltaic apparatus with which they are provided."

The analogies here stated are certainly of a singular character. Does Mrs. Somerville suppose that phosphorescent fishes serve for the illumination of those depths of the ocean which the light of the sun is unable to penetrate? Then, as to the change of colour in a species of cuttle-fish found at the Cape de Verd Islands, we, for our own part, see no necessity for travelling so far from home to witness a phenomenon which may

be observed with equal facility in the common Sepiola or Eledone of the British shores.

From a perusal of pages 346–47, we are led to believe that our authoress accepts as true the views of the late Professor E. Forbes with regard to the existence of specific centres, while, at page 394, she infers, from the fact of *Vanessa cardui* having been found in each of the four quarters of the globe, that each particular species must have been originally created in the places they now inhabit.

The few paragraphs which profess to explain the leading facts which have been recently brought to light concerning the distribution of marine animals are, in our opinion, most unsatisfactory. What can be more confused than the following passage, which contains errors of so manifest a character that any particular allusion to them must seem unnecessary:—

"From the surface to more than 100 fathoms in the Arctic and boreal belts there are five distinct zones of depth. The first, or littoral zone, which extends to a depth of fifteen fathoms, is distinguished by the genera Littorina or turbo, the Purpura or whelk, and the Patella or limpet; the other four contain various kinds of mollusca, star-fish, sea-urchins, sponges, corallines, and sea-weeds. The most remarkable of these is an arborescent star-fish which inhabits the depths of the North Atlantic, and the *Comatula Europea*, belonging to the stone-lily family, or crinoids, which are fixed to the rocks when young, but become detached when full grown: they are numerous in the Arctic seas to the west of Spitzbergen; one is met with in the Indo-Pacific Ocean, and a species has been found in Dublin Bay. They are the last representatives of those beautiful zoophytes which characterized the oolitic period. The larger Crustaceæ are exceedingly numerous in this belt, especially on the rocky coasts and islands of Norway, where an extensive fishery supplies the English, Dutch, and French markets with crabs and lobsters."

The physiological information which Mrs. Somerville conveys is, no doubt, sufficiently extensive, though, like the rest of her writings, it is characterized by incompleteness and inaccuracy. Thus, for example, at page 450, we are told that—

"Herbivorous animals inhale oxygen in breathing, and as vegetable food does not contain so much carbon as animal, they require a greater supply to compensate for the wasting influence of the vital air; therefore, cattle eat more frequently than those which feed on animal food."

From the ordinary rules of grammar, we must suppose that the word "those" in the concluding portion of the sentence just quoted refers either to cattle or herbivorous animals; but if either of these expressions be inserted, the sense of the passage is manifestly destroyed. But, waiving this objection, it may be said that our authoress has mentioned one only of the reasons why cattle are obliged to eat more frequently than carnivorous animals, the comparatively small amount of histogenetic material contained in vegetable food being, we need hardly inform our readers, the true cause of the difference in question.

The concluding chapter of the book is more promiscuous in its contents than any of the others, embracing an extensive variety of topics in connexion with Man,—his influence, free will, the progress of civilization, poetry, fine arts, &c., &c.,—"bringing to a close a work which"

(we quote the words of the authoress) "may in some measure be considered a kind of *resumé* of natural knowledge." As such, it cannot fail to prove interesting to those who feel proud of the success which Mrs. Somerville's has achieved, seeing that she undoubtedly occupies the foremost place among the female scientific writers of our day.

For the general getting up of the work the publisher's name will be in itself a sufficient guarantee, and in the present instance we must admit that he has produced a volume well fitted to lie on the drawing-room tables of the great, there to be often looked at with admiration, but never to be read. As such, we recommend it; but we would warn the earnest student seeking after truth, and hoping to find it in the volume of Mrs. Somerville, to beware ere he accepts as true, statements conveyed in unscientific language, and too often gathered at second-hand. Every compilation must, of necessity, be erroneous: no scissors can supply the place of the pen.

On the Recent Foraminifera of Great Britain. By William Crawford Williamson, F.R.S., Professor of Natural History in Owen's College, Manchester. 4to, pp. 100, with seven Plates. Printed for the Members of the Ray Society. 1858.

We are too thankful to see on our table another volume of the Ray Society's publications to quarrel at the period of the year at which it makes its appearance; and indeed, seeing Mr. Williamson's "Foraminifera" has not haunted us nearly as long as Professor Allman's "Polyzoa," it might be as well for us not to find fault with the exact date of publication, but proceed forthwith to examine the production which, through the medium of the Ray Society, has been given to the world.

We are told in the introductory notice that this thin quarto is to be regarded as a monograph of the "Recent British Foraminifera," and that one that is yet to come, and which shall review the "various modifications of their structure, their zoological affinities, and their geological history,"—one which shall, in fact, be the "entire history of the Foraminifera,"—is to act as an Introduction to this. We have often heard of Prefaces that were longer than the volume they prefaced. We will have seen one when this "Introduction" makes its appearance.

The author, in his attempts to classify these minute organisms, was perplexed by the fact, that it is almost impossible to determine what amount of variation is compatible with specific unity. "Even among the higher animals it is a question hard to be decided; but among such lowly creatures as Foraminifera, it is one very much more puzzling." The author does not believe in the absence of specific distinctions; but, in language which for excessive clearness we have never seen surpassed, says:—"But we have hitherto failed to detect the real specific peculiarities, or even to ascertain in what part of the living organism they are

likely to be found. As yet they are but unseen potentialities, of which the eye has hitherto been unable to detect any concrete or objective manifestation."

We have several instances given of spontaneous fission existing amongst the soft animals of the Foraminifera. "In each of these examples," says Professor Williamson, "there appears to have been an abortive attempt at division of the uncalcified germ, which attempt the premature supervention of the calcifying process has arrested. Whenever such specimens occur, it invariably happens that the two halves of the twin organism belong to the same variety or type, and these specimens indicate that fission tends to repetition of identical types, and not to differentiation."

We have some very useful information given as to the localities and modes of collecting these creatures. Fifty-six species, or so-called species, are described, with an endless number of varieties. We cordially agree with the author, that the time has not yet arrived when we can pronounce which is a species, and which a variety. The Plates, seven in number, are most beautifully executed by Tuffen West, and we trust will help to illustrate the promised "Introduction," which may we live to see!

Manual of Land and Fresh-water Shells of the British Islands; with Figures of each of the Species by W. Turton, M.D. New Edition, with Additions by J. Edward Gray, Ph.D., F.R.S., &c. 8vo, with twelve Plates and numerous Woodcuts. London: Longman and Co. 1857.

It is now something more than a quarter of a century since Dr. W. Turton published his "Manual of the Land and Fresh-water Shells of the British Islands," and we wonder what he would have said or thought if he had lived to see the pretty volume whose title stands at the head of this notice grow out of his own thin octavo of some 150 pages. We have some doubts ourselves whether the little volume of 1831 is not as useful as its great fat grandchild of 1857. We think that there is a want of some manual of both the marine, and land and fresh-water Mollusca (if for convenience we allow this arbitrary division), which, without incumbering the student with anatomical details or well worked-out synonymic lists, shall afford him fair diagnoses of the families and genera, and such descriptions of the species as may enable him to be pretty certain of the native ones, referring him all the time to the classic volumes of Forbes and Hanley for matters of detail. This desiderata, even as regards the land and fresh-water shells, is not, in our opinion, supplied by this volume of Dr. Gray's, for the original 150 pages of Turton have well nigh completely vanished from the book. It aspires more to the

elaborate completeness of a monograph than the student or lady reader will, we think, care for or appreciate. The author's elaborate classification, the vast knowledge of contemporary history which is displayed in the synonyms attached to the species, and in the details of structure, taken from Clark, Troschel, and others, is, we might almost say, thrown away on the ordinary readers of Gray's Turton, one-fourth of whom know not the amount of book knowledge which even this small volume exhibits, an amount which, in our opinion, is only equalled by the ready kindness with which the possessor thereof imparts to others the knowledge he has himself acquired.

We know we should not be able to agree with the author's division and subdivision of our land and fresh-water Mollusca, and so we refrain from noticing it, our space not allowing us to do the subject justice, and, moreover, it is a task not quite so gracious but that we would fain avoid it.

We must, however, very severely condemn the carelessness that is exhibited in the localities given as frequented by the Mollusca mentioned. As often as we find works emanating from the pens of British naturalists, purporting to give British localities, and withal excluding or barely alluding to Ireland, so often will we assert that it displays ignorance or carelessness of a most unjustifiable character on the part of the author; for there is, and for years long since has been, a band of Irish naturalists to whom it would be a pleasure and a loving duty to assist to their utmost the writers on any subject within their ken; and if Dr. Gray knew as much of our green island as Dr. Turton, we would have found more profit in this respect in the perusal of his pages. Even the common shells of Dublin—centre though it be of Irish naturalists and Irish science—are not in some instances recorded; and one (*Helix pisana*) that occurs in such profusion all along the Rush coast, is here "*said* to be found near Dublin."

With all its faults, we still regard the book with a very friendly feeling. The woodcuts are an important addition to the work; the analytical index to the species is such as to enable every one to find them, though we think it might have been framed so as not to have mixed up genera totally unrelated to each other.

The general appearance of the volume, as regards fair paper, clear type, neatly executed plates, is quite refreshing; and, hoping that on the appearance of the next edition our friends on this side the Channel may be laid under contribution, we would recommend it to such of our readers as are interested in British Malacology as a useful addition to their bookshelves, and a good companion to their studies.

ESSAY ON COMPARATIVE PETROLOGY; OR, RESEARCHES ON THE CHEMICAL AND MINERALOGICAL COMPOSITION OF IGNEOUS ROCKS; ON THE PHENOMENA OF THEIR ERUPTION; AND ON THEIR CLASSIFICATION. By M. J. Durocher, Mining Engineer and Professor of the Faculty of Science at Rennes.

[Translated from the "Annales des Mines," vol. xi., 1857.]

Object of the Memoir.—This Essay gives the general results of a series of researches in which I have been engaged for a long time on the igneous rocks, and which are not yet completed; some of them, however, have already appeared in various journals, viz., "Voyages en Scandanavie," "Comptes rendus de l'Academie des Sciences" (tom. xx. p. 1277; tom. xxiii. p. 978; tom. xxv. p. 208; and tom. xliv. pp. 325, 459, &c., &c.); the "Bulletin de la Societé Geologique" (2nd ser. tom. iv. pp. 409, 1018; and tom. vii. p. 276); and the Memoirs of the same Society (2nd ser. tom. vi. first part).

For many years the eruptive rocks have been the subject of important investigations, both in France and Germany; but these investigations have only given rise to works of detail, of which the object is to determine the mineral species found in the rocks. The present Essay is a "Memoir on Comparative Petrology," and ought to be considered as an attempt at a general synthesis of the pyrogenous rocks, considered in the fourfold point of view,—of their Chemical constitution, their Mineralogical composition, their Eruption, and their Classification.

PART I.

REDUCTION OF ALL THE IGNEOUS ROCKS TO TWO MAGMAS.

Office of Silicon in the Mineral Kingdom.—In the mineral kingdom Silicon performs a part analogous to that of carbon in the organic kingdom; and in its behaviour, as a polybasic acid, silica unites with the oxides in various proportions, and thus gives rise to numerous combinations. Most of the mineral species which thence result, and especially those which enter into the composition of the crystalline rocks, arise from combinations of elements which are always the same, and whose total proportions in the mass containing them vary only within narrow limits. In seeking the mineral silicates, whose aggregation constitutes rocks, it is not necessary that each association forming a distinct rock mineralogically should also correspond to a special chemical composition of the Magma which produced it. This appears to me to constitute one of the most important views of the study of rocks, and the researches which I have undertaken on this subject have led me to results remarkable for the simplicity which they introduce into the history of igneous formations, and which, besides being founded on experimental data, appear to me to agree perfectly with geological observations.

All Igneous Rocks derived from two Magmas.—An immense number of consequences may be logically derived from the following proposition, the proof of which I shall furnish presently, viz.:—*That all igneous rocks, modern and ancient, were produced by two Magmas, which coexist below the solid crust of the globe, and occupy there each a definite position.*

These two Magmas have undergone but slight changes of composition from the most remote geological epochs; and, moreover, they differ essentially from each other by means of well-defined characters. The one may, from its excess of silica, be called the Acid Magma; while the other is comparable to a basic salt; for its silica is not in sufficient quantity to saturate its metallic oxides. The difference of silica in the two Magmas is in the proportion of 7 : 5. They contain nearly the same quantity of Alumina; but the Siliceous Magma contains from one and a half to twice as much alkalies, and more Potash than Soda, while the reverse occurs in the Basic Magma. The first is specially characterized by its poverty in earthy bases, and the iron oxides; of these, it contains from six to eight times less than the other.

The following Table gives the composition of these Magmas, and the specific gravities of the rocks derived from them.

TABLE I.

Proportions of Elements.	Silica.	Alumina.	Potash.	Soda.	Lime.	Magnesia.	Oxides of Iron & Manganese.	Water, Fluorine, Carbonic Acid.	Sp. Gr. of Rocks. 1st. Natural.	Sp. Gr. of Rocks. 2nd. Vitrified artificially.
GENERAL LIMITS OF PROPORTIONS IN THE IGNEOUS ROCKS.										
1. Siliceous,	62 – 78	11 – 20	3 – 6	1 – 6	½ – 2	½ – 2	½ – 4	½ – 3	2·4 – 2·7	2·35 – 2.46
2. Basic, .	45 – 58	11 – 20	½ – 3	1 – 6	5 – 12	3 – 12	7 – 20	½ – 4	2·8 – 3·2	2·5 – 2·84
MEAN PROPORTIONS IN THE TWO MAGMAS.										
1. Siliceous,	71·0	16·0	4·5	2·5	1·0	1·0	2·5	1·2	2·65	2·40
2. Basic, .	51·5	16·0	1·0	3·0	8·0	6·0	13·0	1·3	2·95	2·72

By combining the results I have obtained by chemical and mechanical analysis with those of analyses already published by various mineralogists, I have established that igneous rocks of crystalline texture, and almost all compact or vitreous masses, formed by fusion, and wrongly considered as minerals, are derived from one or other of these Magmas. To the first are referable all the Granitic rocks, including the Eurites, Quartziferous Porphyries, and Petrosilex, the Trachytes, Phonolites, Perlites, Obsidians, Pumices, and Lavas, with Vitreous Felspar. To

the second belong the Diorites, Ophites, Euphotides, Hyperites, Melaphyres, Traps, Basalts, and Pyroxenic Lavas.

Origin of Mineralogical Differences in Igneous Rocks.—I should also remark, that if we analyze various kinds of the same group of rocks—granites, for example—we often find more difference in the relative proportions of elements, between two specimens of the same type of rock, than there is between granite and a rock altogether dissimilar in appearance,—say a Trachyte or Pumice. We should conclude from this fact, that in rocks derived from the same Magma differences of mineralogical composition arise less from their elementary composition than from conditions of pressure, temperature, and in general the circumstances of their cooling; that is to say, from conditions of an *external* rather than an *internal order*. The Magmas which have produced the igneous rocks are comparable to baths containing many metals in a state of fusion, and which, in setting, are divided into alloys, different, according to the circumstances of their cooling, even when the original bath has the same composition.

Products of the Zone of Contact of the two Magmas.—Moreover, the zone of contact of the two Magmas should give out products of an intermediate character; and this is, in fact, the case; and from this zone appear to arise the Syenites, the Protogenes rich in talc, the Trachytes rich in pyroxene and amphibole, and various porphyries which are intermediate between Granitic or Trachytic porphyries, and Amphibolic or Pyroxenic porphyries. These rocks, which may be called *hybrid rocks*, have petrographical and geological affinities of an unsettled character; they seem to belong, sometimes to the rocks of the first, and sometimes to those of the second Magma.

Permanence of Separation of the two Magmas.—The Upper Magma, which is rich in Silica, and poor in earthy bases and oxides of iron, possesses the least specific gravity; and in this respect there are differences among the rocks produced by the two Magmas, from one and a half to twice as great as between oil and water. The separation is still, greater if, in place of considering the rocks in their natural condition, we compare the vitrified products obtained by their fusion: further still if we refer them to their liquid condition, there ought to be, according to Bischoff's experiments, between the rocks arising from the two Magmas, differences twice greater than those observed in their crystalline state, and, therefore, from three to four times greater than those between oil and water: from these facts may be deduced the necessary and permanent separation of the two Magmas.

Fluid Zone situated below the Solid Exterior Crust.—The solid crust of the globe, then, reposes upon a fluid zone, composed of two distinct layers: the upper, which is the most refractory, is only semi-liquid or pasty, in consequence of the predominance of Silica, which is characterized by its viscosity; the second layer, which contains much less silica, and which presents atomic proportions, ranging from a bisilicate to a sesquisilicate, is much more fluid and dense; and also appears to be very

rich in the oxides of iron, especially in certain regions. From this source have emanated those great masses of Magnetic oxide which have burst forth in the fashion of the igneous rocks; and which in Italy, and the Ural Mountains, as in Scandinavia, are connected with the amphibolic or pyroxenic rocks. In the upper layer are collected, by preference, the lighter or more volatile bodies, such as the alkaline metals, fluorine, boron, &c., &c.; and, in fact, it is in the granitic rocks arising from this layer, that we find commonly the fluo or boro-silicated minerals, as mica, topaz, tourmaline, &c., &c.

Part II.

ON THE CHANGES WHICH HAVE TAKEN PLACE IN THE COMPOSITION OF THE TWO INCANDESCENT LAYERS, FROM WHICH THE ERUPTIVE ROCKS HAVE EMANATED.

Comparative Chemical Composition of the Principal Types of Eruptive Rocks.—It has appeared to me interesting to investigate the changes which have taken place, from the earliest epochs of the globe, in the nature of the incandescent layers which constitute the seat of the eruptions: for this purpose it is necessary to compare the principal types of rocks which have burst forth during successive geological epochs. I have determined their average composition, and the limits of the variations which take place in the proportions of their elements, both from my own researches and from the chemical analyses published by various writers, among whom I may mention, in particular, MM. Gmelin, Abisch, Dufrenoy, Ebelmen, Delesse, and Ch. Deville. The results at which I have arrived are contained in the annexed Table.

Changes in the Composition of the Acid Layer deduced from a Comparison of the two great Families of Siliceous Rocks.—The siliceous rocks comprise two great families: the Granites and the Trachytes: their separation is very definite chronologically, for the former belong to the primary or secondary periods, and the latter to the tertiary, quaternary, and modern periods. If, now, we compare the average composition of the two fundamental types of those families, granite and trachyte, and consider that they represent the most abundant products of the siliceous layer, we shall find that in the long course of ages that divide the primary and tertiary periods from each other, the following changes took place in the composition of the fluid mass which nourished the eruptions: viz., there was a diminution of $\frac{8}{100}$ or $\frac{9}{100}$ in the proportion of silica, and of $\frac{21}{10}$ in the potash; but that the proportions of lime and iron oxides were almost doubled, and that of soda tripled. If, again, we compare the composition of the trachytes of the tertiary period with that of the trachytic lavas of the actual epoch (and we may cite as a type lava that of the Arso, which was spread over the isle of Ischia in 1301), we shall find that the proportion of silica has diminished still further, remaining, however, greater than the quantity contained in the various rocks ejected from the basic layer; while the soda has increased by more than $\frac{50}{100}$.

Principal Types of Igneous Rocks.			Specific Gravities. Natural. Limits.	Mean.	Vitrified.
Siliceous Rocks.	Granitic Group.	Granites, ...	2·60 – 2·73	2·66	2·39
		Eurites, ...	2·58 – 2·70	2·64	2·36
		Petrosilex, ...	2·58 – 2·68	2·64	,,
	Trachytic Group.	Trachytes, ...	2·60 – 2·70	2·67	,,
		Trachytic Lavas, ...	2·58 – 2·64	2·62	2·46
		Phonoliths, ...	,,	2·58	,,
		Trachytic Porphyry, . . .	2·52 – 2·65	2·58	,,
		Pitchstones and Retinites, .	2·31 – 2·36	2·34	,,
		Perlites, ...	2·34 – 2·40	2·37	,,
		Obsidians, ...	2·25 – 2·55	2·40	2·34
		Pumices, ...	2·00 – 2·53	2·30	2·46
Degradation of Siliceous Rocks.	Trachytic.	Syenitic Granites, ...	2·63 – 2·75	2·68	2·45
		Andesites, ...	2·58 – 2·72	2·67	,,
Hybrid Rocks.	Ancient.	Syenites and Syenitic Porphyries, ...	2·67 – 2·78	2·73	,,
	Modern.	Trachydolerites, ...	2·70 – 2·85	2·78	,,
		Ferrocalciferous Retinites, Perlites, and Obsidians,	,, ,,	2·40	2·49
		Ferrocalciferous Pumices, .	2·00 – 2·57	2·30	,,
Basic Rocks.		Diorites, ...	2·80 – 3·20	2·95	2·66
		Euphotides, ...	2·85 – 3·10	2·95	2·62
		Hyperites, ...	2·85 – 3·10	2·95	,,
		Melaphyres, ...	2·75 – 2·95	2·85	2·60
		Basalts, ...	2·85 – 3·10	2·96	2·84
		Dolerites, ...	2·85 – 3·10	2·95	,,
		Pyroxenic Rock, average composition, ...	,, ,,	2·92	,,
		Doleritic Lavas, ...	2·85 – 3·00	2·92	2·75
		Leucito-augiticalciferous lavas, ...	2·72 – 2·90	2·80	,,
Degradation of Basic Rocks.		Serpentines, ...	2·50 – 2·66	2·58	,,

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TABLE II.

To face page 162.

Principal Types of Igneous Rocks.		Specific Gravities. Natural. Limits.	Natural. Mean.	Vitrified.	Silica and trace of Titanic Acid. Limits.	Mean.	Alumina. Limits.	Mean.	Potash. Limits.	Mean.	Soda. Limits.	Mean.	Lime. Limits.	Mean.	Magnesia. Limits.	Mean.	Oxides of Iron and Manganese. Limits.	Mean.	Loss by Ignition. Limits.	Mean.
Siliceous Rocks. Granitic Group.	Granites,	2·60–2·73	2·66	2·39	66–78	72·8	11–18	15·3	4·0–9·0	6·4	„–2·5	1·4	„–1·5	0·7	„–2·0	0·9	0·5–2·5	1·7	„–1·5	0·8
	Eurites,	2·58–2·70	2·64	2·36	68–78	73·5	11–17	14·5	2·0–7·0	4·0	1·0–5·0	2·8	„–2·0	0·8	„–2·0	0·9	1·5–4·0	2·5	„–1·5	1·0
	Petrosilex,	2·58–2·68	2·64	„	68–80	75·4	11–18	15·0	2·0–6·0	3·1	„–6·0	1·3	„–2·0	0·8	„–2·5	1·1	0·5–4·5	2·3	„–3·5	1·0
Trachytic Group.	Trachytes,	2·60–2·70	2·67	„	64–71	66·5	13–20	17·0	3·0–9·0	5·0	0·5–6·0	4·0	0·5–2·5	1·4	„–2·0	1·1	1·5–5·0	3·0	„–2·0	1·0
	Trachytic Lavas,	2·58–2·64	2·62	2·46	„ „	61·1	„ „	17·2	4·0–7.0	5·5	4·0–8·0	6·3	1·0–2·0	1·5	„–2·0	1·1	„ „	5·2	0·5–2·0	1·5
	Phonoliths,	„	2·58	„	54–62	57·7	17–24	20·6	3·0–9·0	6·0	3·0–14·0	7·0	„–3·5	1·5	„–2·0	0·5	1·5–4·5	3·5	1·0–3·5	3·2
	Trachytic Porphyry,	2·52–2·65	2·58	„	68–75	72·8	13–14	13·5	3·0–8·0	4·9	1·5–7·0	4·2	„–1·0	0·5	„–2·0	0·7	1·0–3·0	1·7	„–5·0	1·5
	Pitchstones and Retinites,	2·31–2·36	2·34	„	62–74	70·6	11–17	15·0	„–6·0	1·6	1·5–3·0	2·4	1·0–1·5	1·2	„–2·0	0·6	1·0–4·0	2·6	„–8·5	6·0
	Perlites,	2·34–2·40	2·37	„	70–77	74·2	12–14	13·0	„–5·0	3·0	„–3·5	2·2	0·5–2·0	1·2	„–1·0	0·6	1·5–2·5	2·1	2·0–4·5	3·7
	Obsidians,	2·25–2·55	2·40	2·34	61–78	71·0	10–19	13·8	„–7·0	4·0	„–11·0	5·2	„–2·0	1 1	„–1·0	0·6	2·0–6·0	3·7	„–1·5	0·6
	Pumices,	2·00–2·53	2·30	2·46	61–77	68·8	10–18	14·0	1·5–6·0	3·7	„–11·0	6·0	„–2·0	1·1	„–1·0	0·6	0·5–4·5	3·2	0·5–4·0	2·6
Degradation of Siliceous Rocks. Trachytic.	Syenitic Granites,	2·63–2·75	2·68	2·45	64–72	69·0	12–17	15·0	3·0–6·0	4·2	1·0–3·5	2·8	1·0–4·0	2·2	2·0–4·0	2·6	2·0–5·0	3·2	„–1·5	1·0
	Andesites,	2·58–2·72	2·67	„	63–67	65·0	13–16	15·0	2·0–4·5	3·2	2·0–5·0	3·5	2·0–4·0	3·0	3·0–4·0	3·5	„ „	5·8	„–1·0	1·0
Hybrid Rocks. Ancient.	Syenites and Syenitic Porphyries,	2·67–2·78	2·73	„	56–65	62·5	12–18	15·5	2·0–4·0	2·9	2·0–6·0	3·2	2·0–5·0	3·0	2·0–5·0	3·5	7·0–10·0	8·4	„–3·0	1·0
Modern.	Trachydolerites,	2·70–2·85	2·78	„	56–62	59·0	15–20	17·0	0·6–3·0	1·5	3 0–7·0	5·0	2·0–8·0	5·3	2·0–5·0	3·2	5·0–12·0	8·0	„–1·5	1·0
	Ferrocalciferous Retinites, Perlites, and Obsidians,	„ „	2·40	2·49	67–70	69·0	3–11	8·7	„–7·0	3·0	3·0–6·0	4·5	3·0–8·0	6·0	1·0–3·0	1·8	3·0–11·0	6·0	„–3·0	1·0
	Ferrocalciferous Pumices,	2·00–2·57	2·30	„	62–70	65·0	10–17	14·0	„ „	1·6	2·5–5·0	3·6	1·5–3·0	2·7	3·0–4·0	3·5	7·0–9·0	8·0	„–2·5	1·6
Basic Rocks.	Diorites,	2·80–3·20	2·95	2·66	48–60	53·2	13–20	16·0	0·5–2·0	1·3	1·0–3·0	2·2	3·0–9·0	6·3	2·0–10·0	6·0	10·0–20·0	14·0	„–2·0	1·0
	Euphotides,	2·85–3·10	2·95	2·62	45–54	49·0	12–17	15·0	„–1·0	0·3	0·5–4·0	2·5	6·0–14·0	9·5	7·0–15·0	9·7	8·0–14·0	11·5	1·0–6·0	2·5
	Hyperites,	2·85–3·10	2·95	„	48–55	51·8	12–16	14·5	„–1·0	0·2	1·0–3·0	2·0	5·0–9·0	7·6	6·0–14·0	9·3	8·0–19·0	14·0	„–1·0	0·6
	Melaphyres,	2·75–2·95	2·85	2·60	49–55	52·2	18–25	21·6	„–3·0	1·5	2·0–6·0	4·0	4·0–8·0	6·2	3·0–5 0	4·0	5·0–12·0	9·0	1·0–3·0	1·5
	Basalts,	2·85–3·10	2·96	2·84	42–53	48·0	10–18	13·8	0·5–3·0	1·5	2·0–5·0	3·0	7·0–14·0	10·2	3·0–10·0	6·5	9·0–16·0	13·8	1·0–5·0	3·2
	Dolerites,	2·85–3·10	2·95	„	45–55	51·0	12–16	14·0	„–1·0	0·2	2·0–5·0	3·4	7·0–13·0	10·0	3·0–9·0	5·5	9·0–18·0	14·7	0·5–3·0	1·1
	Pyroxenic Rock, average composition,	„ „	2·92	„	„ „	50·2	„ „	16·5	„ „	1·1	„ „	3·5	„ „	8·8	„ „	5·3	„ „	12·5	„ „	2·1
	Doleritic Lavas,	2·85–3·00	2·92	2·75	48–53	50·0	13–18	15·5	„–1·0	0·3	1·0–4·0	3·7	7·0–13·0	10·0	4·0–7·0	5·0	10·0–17·0	14·5	„–2·0	1·0
	Leucito-augiticalciferous lavas,	2·72–2·90	2·80	„	49–53	51·0	15–18	16·6	3·4–4·4	4·0	5·0–8·0	6·6	6·0–12·0	9·0	1·0–6·0	3·0	6·0–12·0	9·2	„–1·0	0·6
Degradation of Basic Rocks.	Serpentines,	2·50–2·66	2·58	„	40–45	42·5	„–3	0·8	„ „	„	„ „	„	„–3·5	0·8	34·0–44·0	39·5	1·0–8·0	3·4	9·0–15·0	13·0

The double commas, in this Table, denote percentages less than one-half.

Changes of Composition in the Basic Layer.—Let us see if changes of the same kind have taken place in the composition of the lower ferro-calciferous layer of fluid, including the Diorites, &c. The Diorites are the most ancient of the basic rocks, and were ejected the most abundantly in the earlier geological periods. But towards the end of the secondary period, and during the tertiary, they have been generally replaced by the pyroxenic rocks, which present three principal types, viz., Melaphyre, Basalt, and Dolerite. Their chemical composition is sensibly different, although they proceed from the same focus, and I have thought that to obtain the composition of the liquid layer from which they proceed, the best method would be to take the mean of the compositions of the three types. We thus obtain a general term of comparison, which I have called in my Table, *Pyroxenic Rock of average composition*, and which represents the whole group of *modern basic rocks* as distinguished from the Diorites, which represent the *ancient basic rocks.* By comparing the numbers thus obtained with those presented by the Diorites, we can appreciate the changes which have taken place in the ferro-calciferous fluid layer, from the primary to the tertiary period. We see thus that there was a sensible diminution of silica and potash, and a notable augmentation of soda and lime. The proportion of soda has continued to increase still later, for our actual volcanic products contain still more than those of the tertiary period. The proportion of iron appears to have diminished rather than increased, but I should observe that the masses of magnetic oxide are connected with the Hornblende rocks, and it is to this circumstance that the richness in iron of the Diorites is due, while a special cause tends to impoverish some of the actual volcanic products; that is, the influence of Chlorine, which carries away the iron in the state of vapour.

Similarity of the changes undergone by the Acid and Basic Layers.—We may recognise a remarkable similarity in the changes experienced by the Acid and Basic layers; in both there has been a decided diminution of Silica and Potash, while, on the contrary, the proportions of lime and soda have augmented. But the two layers remain, nevertheless, distinct, and the Trachytic products which represent the deeper portions of the Siliceous layer differ much less in the whole of their elements from the Granites (even the most ancient), than they do from the Diorites, or any other product of the basic layer. As to the hybrid rocks which issue from the zone of contact of the two layers, my Table shows that, as well by chemical composition as in mineralogical characters, they form a sort of tract of union between the two systems, although they seem to approach somewhat nearer to the siliceous rocks.

Causes of this Change of Composition.—The diminution of silica and potash in the modern rocks of the Acid and Basic group seems to me to arise from the fact, that those elements were concentrated towards the upper portion of the fluid zone, on account of their low specific gravity: and, on the contrary, the proportion of lime should increase with the depth. But the increase of soda in the eruptive products of the later

epochs of the globe, an increase which becomes more and more decided down to our own epoch, and which is not in harmony with the changes in the proportions of the other elements, appears to me to be due to a special cause: it appears to be difficult to give an account of it, without admitting the intervention of sea-water in the formation of igneous products, at least during the later geological periods. Thus, like M. Abisch, I am led by my researches on rocks to consequences having points in common with the explanation which H. Davy had deduced from his studies on volcanic phenomena; but it does not appear to me to be necessary to suppose unoxidized alkaline and earthy metals to exist in the incandescent zone which covers the earth's surface.

Three orders of facts require the intervention of sea-water in volcanic phenomena.

The intervention of sea-water in volcanic effects appears to me to be based upon three great orders of facts:—

1°. The action of elastic fluids, much more marked at present than formerly, on the phenomena and rocks of eruption.

2°. The nature of these elastic fluids, among which are found in abundance aqueous vapour, hydrochloric acid, and the chlorides and acids of sulphur.

3°. The considerable increase of soda in the more modern of the igneous rocks, whether they be derived from the acid or the basic layer; I should add, that this substitution of soda for potash is accompanied by the replacement of fluorine by chlorine.

I might also add that many volcanic products contain, not merely organic matters, but, according to the observations of M. Ehrenberg, recognisable traces of organized beings, which prove clearly the addition of external elements in the formation of those products, whilst there is nothing similar in the ancient granitic rocks, which constitute purely *endogenous* masses. I am aware that there are certain difficulties inherent in the hypothesis of an intervention of sea-water in volcanic action, but these difficulties are not insurmountable; and we must, of necessity, take account of the whole of the facts I have noticed, as tending to the same conclusion.

Circulatory Movement of Soda.—We know, moreover, that the sodiferous silicates are more easily decomposed than the potassiferous silicates: thus in mineral waters, as in the sea-water, soda is the dominant alkali. It seems thus destined to a continual circulatory movement: removed from the rocks in decomposition by the infiltrated water, then, transported to the sea by running water, it is brought back by deep crevasses to the subterranean foci, from which it issues again, partly as vapour, and partly incorporated in the lavas.

(*To be continued.*)

Correspondence.

ARCTIC VOYAGES.

We have been favoured by Dr. M'Clintock with two letters from his brother, Captain F. Leopold M'Clintock, from Baffin's Bay. We now print them for the information of our readers; and also two letters to Captain Collinson and Mr. John Barrow, which have been already published in the "Times" newspaper. To these we have added Dr. Walker's "Diary," published in the "Belfast News-Letter" of September 8, 1858, which many of our readers may not have seen:—

I.—CAPTAIN M'CLINTOCK TO DR. M'CLINTOCK.

"*Commenced at Sea, April* 26, 1858;
closed at Holsteinborg, May 7.

"My dear Alfred,—As you are not likely to see me before 1859, I must only write you the reason why; it is capable of being made a long story of, but I shall be as brief as I can. When last I wrote to you we were starting from that outpost of civilization—Uppernavik, August 6 (1857), all well, but prospects rather clouded by the information we received there respecting the state of the ice and season. We reached the edge of the middle ice, or great 'pack,' two days afterwards, a little to the south of Uppernavik, and finding it impenetrable, coasted along it up to Brown's Islands in the depth of Melville Bay. The usual mode of getting round this bay is by holding fast to the land or fixed ice, which adheres to the shore, and extends for miles to seaward, and then making progress as the off-shore winds blow off the moveable ice or 'pack.'

"But we found that all the land ice had been broken up, even to the foot of the glacier, which extends straight from point to point; and after waiting some days, a favourable change appearing, I took advantage of it to push straight across the bay for Cape York. There was indeed no alternative, but fortune deserted us: a change of wind and heavy gale closed up all the openings in the ice, and left us helplessly beset on August 18.

"We continued to drift (as I expected) onward to the north-west, but a shoal, which it has been our misfortune to discover off Cape York, stopped the progress of several large icebergs, and they stopped the ice in which we were stuck fast. At length we drifted past the grounded bergs, but the season was gone—ice forming rapidly over every fresh crack or pool; and it became evident to all that we must winter in the pack, drifting, of course, wherever the winds or currents impelled it! You will understand how deeply I was disappointed; at the very best, I could only hope for a release in the spring of this year in time to renew our work, should the efficiency of the ship and the crew be equal to the task. Thank God, this hope has been fully realized: we escaped from

the pack only two days ago (April 25), and expect to reach Holsteinborg to-morrow, where I intend spending a fortnight to recruit and refit. Poor Lady Franklin—I greatly pity her—it is an intense disappointment; with us it is over, but she has yet to learn it! Now for our winter and our ice-drift.

"Having got the ship into as safe a nook in a stout old floe as I could when we were first beset, we did not receive any squeezes, and soon became firmly frozen in; and although at intervals during the whole winter wide lanes of water would open, and again these would close, the ice-edges meeting and crushing up with more than sufficient force to crush the strongest ships, yet we were unharmed,—no violent pressure ever taking place within fifty yards of us. The ice carried us about with every wind; but as northerly winds blow almost incessantly throughout the winter, we travelled a long way to the south.

"In October we were in latitude 75½° N., and longitude 70° W. By February 1, 1858, we were abreast of Uppernavik, in latitude 72½° N., and longitude 61° W. By the 1st April we were in latitude 68° N., and longitude 59° W. On the 13th we passed near the position of De Haven, when he got out of the pack after his winter's ice-drift from Wellington Channel (June 5, 1851). On the 25th, when we were able to effect our escape, we were in latitude 63° 40′ N., and longitude 59° W. To this I have only to add our position when we first became helpless and commenced drifting with the ice on August 18: latitude 75° 17′ N., longitude 62° 8′ W.

"If you take a Baffin's Bay chart, and draw a zigzag line through these points, you will at once see clearly *where* we have spent our winter. Being a solitary little vessel, with a small crew, our winter was extremely monotonous. The Doctor (Walker) and I got as much amusement out of the meteorological observations as we could. We took the temperature, the barometer, the aneroid, the winds, and weather, the ozone, and the thickness of the ice and snow, continually. Moreover, Walker was continually on the look-out for auroras, parhelia, haloes, snow crystals, &c., and was sometimes successful in catching electricity, detecting its presence in the atmosphere by means of a gold-leaf electrometer and copper wire attached aloft. Hobson, Young, and Petersen were always on the look-out for something to shoot, and succeeded in killing and securing seventy-one seals, two bears, one fox, and a few dovekies. The *take* of seals is unprecedented, and has supplied our dogs with food up to the present time. The fox was killed when we were 120 geographical (140 English) miles from the nearest land, and he was very fat, living upon such few dovekies as were silly enough to spend their winter in the pack. The men have behaved admirably, always cheerful, and full of high hopes,—thorough-going men of war's men.

"We had our school during the winter evenings, when Walker and Young taught navigation, writing, and arithmetic. Walker also gave a few lectures on popular subjects, and every Sunday evening has made a practice of reading a portion of the New Testament, and explaining it to such of the men as chose to attend. The last week in the 'pack' was

to me, and I think to all of us, the most unendurable of the whole; drifting into the Atlantic at the rate of twenty miles daily.

"A heavy gale of wind threw in such a high sea against the ice on the 24th, that, although we were twenty miles within its margin, the ice was suddenly broken up into small pieces—that is, averaging about half the area of the ship's deck; with sail and steam, and God's help, we got out, after eighteen hours of such battering as I hope not to see again. As we advanced to the edge of the pack, the sea became more violent, and the ice still so closely pressed together that we could hardly force the masses aside, much less escape the fearful shocks they gave us. I shall never forget the 25th of April, and hope some day to describe to you our escape, if such a scene can be described.

"Well, here we are, safe and sound; no sickness has at any time visited any of us. The 'antiscorbutic specific' from New York has not been called into requisition; our provisions have been excellent and ample, and with attention to cleanliness, and clothing, and exercise, we have retained unbroken health.

"Building snow-huts gave us useful occupation, and we are now very good architects; four or five of us can house ourselves in less than half an hour. I feel indebted to all my companions for their good will and cheerfulness, and devotion to the expedition. This year we hope to carry out our purpose, God willing. My plans are unchanged with respect to the search; but being so early in the field, and the winter having been mild, I hope to reach Lancaster Sound early. Of provisions we have abundance for another winter, and at Beechy Island I shall take on board enough for a third winter, as a measure of precaution against forced detention. I will write to you again before leaving Greenland, but hope to get this home by an early vessel.

"April 29th. We arrived in Holsteinborg yesterday evening, and are now enjoying a calm, warm day in quiet and security, the first for a long, long time. The Danish vessel is daily expected here, and should she arrive before we sail, we shall have European news of this year. If Lady Franklin has sent out letters this year to me through the Danish ships (which I do not expect), we shall probably receive them before we again leave Greenland. In about a fortnight I propose sailing for Disco. It is strange that the winter we have experienced in the pack should differ so widely from that which the people here have had. Ours was mild, but stormy: here it has been cold and calm.

"May 5th. Hardly any supplies to be got here; the Danish ship has not arrived, and now the Governor fears she has gone to a more southern port instead. However, our letters must go in either case. I shall sail in two or three days for Goodhavn, Disco, from which port, or by the whalers, I will write again.

"Pray remember me most affectionately to all dear friends; to ask you questions would not relieve my anxiety respecting them.

"Believe me ever affectionately yours,

"F. L. M'Clintock."

II.—SAME TO SAME.

"*Arctic Searching Yacht, 'Fox,'*
"*Goodhavn, Disco, Greenland, May* 24, 1858.

"MY DEAR ALFRED,—I write you a few lines to say that we are in a fair way of pushing north again, and are all in excellent health. The spring has been late, but the weather is now making amends to us. We have received newspapers from the whalers up to March 19, and also some fresh English beef and potatoes. Here I have got some light beer brewed for my crew, and intend sailing to-morrow morning for the Waigat Strait, in which there is a coal seam to tempt a visit. If I can, I will complete my stock of coals there, and then go northwards towards Melville Bay as fast as the ice permits. The whaler captains are generous: they give us what they can share, but will not accept payment in return. I intend to touch here on my way home in September, 1859 (D. V.) to land two Esquimaux lads that I have taken with me as dog-drivers, so you can write to me next spring by the Hull whalers. But of this I will tell you more fully when I send home my last letters by those vessels. We shall be with them, in all probability, until we reach Pond's Bay. The prospect of having something to do is most cheering, and if all ends well, I shall never regret the lost year.

"I do not see any mention of the 'Resolute' in the papers, so conclude nothing was done by way of a 'Bhering's Straits Expedition' last year. Nor have I seen Maguire's appointment to a ship. Now that I have a whole season before me, and ample time to search north and south along the ice, I am sanguine of getting through to Pond's Bay early, and of doing good work. The Chinese war has no charms for me. I have collected some few specimens for Carte, and for my own little studio, to be established at some future period, perhaps, and will send my gatherings home in a whaler, lest the 'Fox' should become a fixture, like many of her predecessors in the search.

As I told you in my last letter, written at Holsteinborg May 6, it is my intention to complete provisions and clothing at Beechy Island for two years more, so that I may have one year's supply to spare. The weather is now beautiful, and almost warm. In Mr. Olrik's house the flowers in his windows are in full blow (inside the house, of course). I have some of his roses upon my table now. He is a clever and agreeable man; speaks English well, although born in Greenland. You will get this, I hope, in October, and, a month later, those letters which I intend to send home by the whalers. I am glad to see a further reduction in the income tax.

"Remember me to all dear friends, and
"Believe me ever yours affectionately,
"F. L. M'CLINTOCK."

"III.—CAPTAIN M'CLINTOCK TO CAPTAIN COLLINSON.

"*Yacht, 'Fox,' Holsteinborg,*
"*Commenced May* 3, 1858; *closed May* 7.

"MY DEAR COLLINSON,—Our cruise hitherto has been short and sharp—most lamentably short, indeed, but, thank God, it is not at an

end; the real work is only beginning. We have only got to repeat the attempt this year which failed so signally last year. Our progress was finally stopped in Melville Bay, August 18, from which time up to the 24th of April we remained in the pack, drifting southward with it. While beset, we have drifted down from $75\frac{1}{2}°$ N. to $63\frac{1}{2}°$ N.; the whole amount is 1194 geographical miles. You will understand what disappointment and anxiety this ill fortune entailed upon me. For a whole month in Melville Bay our fate hung in the balance. The season was very similar to 1848, when I was with Sir J. Ross; the whole bay was crammed full of light pack, and there was no land ice. Having previously examined the edge of the middle ice down as far as 72° 20′, without any prospect of success, there was but one course open to me—to enter the pack whenever a favourable opportunity offered, and trust to boring through into the north water. This is what Sir J. Ross did, and, being on the same spot, and also on the same day, and, moreover, a very favourable opportunity of long leads opening out, I tried the same plan. We did not succeed; a long run of southerly winds closed the ice together so much that it did not open again. Still I had the precedent of the North Star from which to draw the hope of a drift through into the north water, and this, I think, we should have done in time to save our season but for the grounding of some bergs on a bank off Cape York, which it has been our lot to discover. We drifted up within twenty-four miles of that Cape, and subsequently far to the westward, before commencing our southern march. But all this you will see in my statement of proceedings and track chart, which I have sent to Lady Franklin. We are thoroughly efficient, but rather short-handed, and I am sorry to add that R. Scott (leading stoker) died on the 4th of December. We are in excellent health, and the ship uninjured. She leaks a little, and we had to pump her out all the winter three times weekly. Forty tons of coal remain on board, and we will take in as much more at the Waigat. As for provisions, we have, excellent in quality, of salt meat seventeen months'; preserved meat and pemmican, thirteen months', &c., &c. From this you see how well provided we are, and how easily we can complete ourselves for a third winter at Beechy Island. With regard to my return plans, I see no reason for departing from my original scheme. If early into the west water, I will thoroughly sift the Pond's Bay natives, so as to separate the history of Belcher's abandoned ships from such knowledge as they may possess respecting Franklin's ships. I hope to look into Port Leopold before Beechey Island, as the former would be the place to which we would have to fall back. If the launch is injured, I will take a boat from Beechey Island, and leave her there, should I go down Bellot Strait, or at Cape Walker, should I succeed in getting down Peel Strait. Should I get down to the Magnetic Pole, I will pass on the east side of King William's Land, communicating with the natives, and into Fish River. If I can manage to complete my work in Fish River by ship, it would be an immense advantage to winter near the south-west angle of King William's Land."

"*Disco, May* 24.

"For the early part of this season I shall be among the whalers, leisurely following their motions, but should they not persevere to the north as long as I think desirable, I must then judge for myself whether to persevere or return south with them, and seek a southern passage. I purpose sailing to-morrow morning. We shall long remember the kindness of Mr. and Mrs. Olrik and all here.

"Yours very sincerely,
"F. L. M'Clintock."

"IV.—CAPTAIN M'CLINTOCK TO JOHN BARROW, ESQ.

"*Arctic Yacht, 'Fox,' Holsteinborg,*
"*April* 28 *to May* 6, 1858.

"My dear Barrow,—Never was there a more beggarly account of empty boxes. Our proceedings are a blank. It is not our faults, you will readily believe, but ice is as capricious as it is stubborn, and so we have found it. Melville Bay appears to me to be precisely in the same state that we found it in 1848, at the same date (15th of August). But last year the southerly winds blew so constantly that the ice became more and more close as the season advanced. But one opportunity offered, and, of course, I availed myself of it, by attempting to reach the north water. We thought we were safe; the water sky ahead was not far distant; but our enemy astern—the south-east wind—came on too rapidly, closed up the ice, and left us helplessly beset on the 18th of August! For nearly a month hope and fear alternated as we drifted slowly across Melville Bay, as the North Star did before us; but a severe September gummed us up, and left us, chafing with disappointment, a legacy to the pack. From the near neighbourhood of Cape York, which was last seen bearing north-east in October, we drifted down past De Haven's position, and finally made our exit from the pack in lat. 63° 35′ N., and long. 58° 25′ W. What a happy release, you will say; and truly so it was. Thank God, we have suffered neither sickness nor hardship; no ice movement disturbed us during the winter, although near enough to excite feelings of gratitude for our preservation. We have lost one valuable man by an accident. He fell down a hatchway, and died of the injuries received. We have not had a single case of illness on board more serious than a cold or headach since leaving England. My crew are all I could desire; their zeal and cheerfulness are beyond all praise. I have sent for Lady Franklin a brief statement of our proceedings; how sincerely I sympathize with her, is more than I can express. However, I am not without hope that the loss of a year is the worst feature in the case. If it pleases God to permit us a moderate share of success, we shall turn out an efficient corps of travellers this autumn. We are now up to all the dodges: we can build our snow huts quite as quickly as even Rae's people, having frequently done so during the winter in less than half an hour! Our provisions are excellent, and ample for another winter, and should we be forced to spend an additional one (that is, a third winter), we have enough of most things of our own, and shall take

care to provide ourselves at Beechey Island with what we may require. My plans are unaltered, except that I shall probably have more time, and will endeavour to get at the bottom of all the Pond's Bay reports. Petersen* is admirable; most faithful, intelligent, and experienced. I hope to obtain, through him, most valuable information. I desire no change in any of my companions, nor do I think any change could be for the better. For myself, I feel no regret at this failure which can at all be named with that which I feel for poor Lady Franklin and all our kind friends at home, including yourself, my dear friend. The disappointment is too great for such minor considerations. Next to the painful suspense of another year, I dread the unavoidable expense of wages—the provisions, clothing, &c., having already been paid for; but I dare not allude to this to Lady Franklin. My hope is, that we may finally be rewarded with such a measure of success that the Government will relieve her of the cost. I wish you could have seen from a balloon our escape from the grip of the ice; I never saw a finer sight! Closely packed heavy ice tossed about by a tremendous sea. Our bow is an acute iron-shod wedge, and, impelled by steam, we slowly advanced, in spite of the most fearful buffetings. Not wishing to 'pile up the agony,' I have said as little as I could about it; but in all my experience I have never witnessed anything approaching to it. In a day or two I shall start for Lievely, the coal-mine, and the further north. I have asked Lady F. to write to me to Lievely next spring, as I hope to touch there on my return in September, 1859. Perhaps you will kindly write also. Excuse the brevity of this scribble, but between writing to the Admiralty and so many friends, my time is occupied, and my wits jumbled up into a strange conglomeration.

"Ever most sincerely yours,
"F. L. M'Clintock."

V.—DIARY OF MR. DAVID WALKER, SURGEON AND NATURALIST TO THE "FOX" ARCTIC EXPEDITION.

"Last letter, dated from Uppernavik on August 6, 1857. In the afternoon weighed and proceeded out to sea, after filling up our number of thirty dogs, and getting some seals for their food. The afternoon was very rough, and the ship rolled and lurched considerably, and rain commenced to fall. Altogether, the evening was very unpleasant. Passed numerous icebergs.

"August 7th. Wind calmer, but still making good way westward. Passed many bergs. Towards evening these increased in size and number. Some rotches and mollymokes were shot. The evening was very pleasant. About 10 P. M. got into the pack ice, and steered through the loose pieces.

"8th. Continued sailing through the ice during the night till 5 A. M., when the ice closed around us, and there we remained till 10 A. M., when

* Mr. Karl Petersen was ice-master with Captain Penny and with Dr. Kane. He is a Dane by birth, but lived many years in Greenland, and is married to an Esquimaux woman.

we got up steam, steering to eastward, and about 2 P. M. got clear of pack, and lowered steam, steering to the south-east, running along the edge of the pack to try and find an opening in it. Bergs in great numbers passed us to-day; at midnight the pack on the lee beam still presenting an impassable barrier.

"9th. Still steering along edge of pack towards north-east. Land was seen in the evening, passing through sailing ice. In the evening rain commenced, and thick fog. Divine service as usual. In the afternoon mounted to the 'crow's nest,' and there remained for some time, in vain looking out for a 'lead.'

"10th. In the morning 'Devil's Thumb' in sight; Wilcox Head and the glacier well seen, though at a great distance, passing many bergs. At 11 A. M. made steam, passing through sailing ice and bergs; the steam was discontinued in the afternoon, and the wind sent us along at a moderate rate. The ice pack remarkably close and dense; towards evening the fog came on very thick, only occasionally lifting, whilst we came whack off the floes as they passed us. We are now up in Melville Bay; some large and heavy bergs alongside of us. At 11 P. M. stuck fast in the ice and fastened to the floe alongside.

"11th. Early in the morning got under weigh again; about 6 A. M. strained our rudder-head by a squeeze from the ice; 10 A. M., still plunging through the ice, the force of the collisions causing the ship to quiver from stem to stern. Last night there was a sudden decrease in the specific gravity of the water, due to the abundance of bergs and the proximity of the glacier. This morning the glacier was very evident, running for many miles along the coast, fringed along its edge by many bergs. At noon hauled alongside a large iceberg, and anchored by three ice anchors, there being no lead ahead. This berg was a large one. I minutely examined its surface, but there were no boulders or other extraneous matter present. The opportunity was taken to fill some of our tanks with fresh water, which was plentifully obtained off the top of the berg, a pond having been formed by the melting of the ice by the heat of the sun. At 3 P. M. a seal was shot by Captain Young, and it was captured; small shrimps filled its stomach. Several others appeared afterwards, but not sufficiently near to get a shot. Some mollymokes, an ivory gull, and one loom, were shot. It has been a most splendid day, the sun shining brilliantly, reflected from floe and berg and glacier; the sea so calm, the sea-birds flying around us, all combined to make a splendid sight. We all wished so much that our home friends could but come out and spend the day with us, in order to form an idea of an Arctic summer's day. The sea deep blue, the berg a snowy white, the sky a light blue, rendered it all but perfect. All we wanted were the green fields and the twitting birds, for our birds sing not. We intend to remain all night, as there is not sufficient ice cleared away to let us proceed.

"12th. This morning, about 7.30, we got up steam and hoved our anchors, and left our friendly berg, steaming in the direction of a lead. We continue our progress, occasionally coming in contact with pieces of the pack. At 1 P. M. we rounded to, in order to fire at a large seal which

was lying on the ice, but, although wounded, he dived down his hole, which was close by. About 2 P. M. the ice began to thicken and be much closer as we neared the land, and by 3 P. M. we were completely hemmed in, and made fast to a berg, a larger one than yesterday's; three anchors made us fast, and again fresh water was obtained, and the dogs embraced the opportunity to take a scamper and enjoy themselves. Captain Young, Petersen, and I went out in a boat in the direction of the glacier, taking plenty of ammunition with us; we pulled to within a mile of the glacier. There was no bird to be seen; a death-like stillness—no sound, no voice was heard, save that of the glacier, at times, cracking like thunder, and a huge iceberg thrown off, causing a roar which extended for miles round. The constant motion of the glacier, edged as it was by icebergs, forbade our nearer approach, and after a vain look-out for seals, or bears, or birds, we returned to the ship, disappointed sportsmen. I noticed the water appearing on surface as if oil had been poured on it, caused by the fresh water (which I tasted) floating some inches thick on the surface of the salt. In the evening the dogs scampered about over the berg, when one, more venturesome than the rest, approached too near the slippery edge, and, unable to stop himself, slid over the edge into the water, a fall of fifty feet, his companions all rushing down pell-mell to the ship, howling most distressfully, completely puzzling the quarter-master on duty, till he espied the unfortunate floating to leeward on a piece of ice he had gained; a boat being sent to the rescue, he was secured. This day was even finer than yesterday, the sun shining most brilliantly, whilst the lesser light is also apparent; no twilight here—now, at 12 P. M., I yet see the sun above the horizon. All is calm; no sound to be heard except the playful cry of the dogs on the berg as they sport among themselves. At present Melville Bay is a pleasant place, but rather dangerous, as it is here that oftentimes the whalers get nipped. Before anchoring we passed inside the line of Browne's Island; our boat is the only European one which has been so close to the glacier.

"13th. This day has been very fine, but marked by nothing of interest; we remained all day fast to the berg, no sufficient opening being apparent. To-day I picked up some pebbles and water-worn specimens off an iceberg, composed of gneiss, quartz, and granite; the berg had evidently been turned upside down, or rather, base upwards. About 6.30 P. M. we got up steam and proceeded S.W., but only advanced about three miles, as the ice was too close and thick; we made fast to a berg at 9 P. M. A boat went out in pursuit of seals, but none were seen; but one dovekie was shot. The evening was beautiful, so calm and quiet; sun visible at 12 P. M.

"14th. This has been a most splendid day, the finest I have yet seen—not a breath of air, and the sun beaming down in full force; scarcely a living thing to be seen. I measured the height of the berg by means of the aneroid, and found it eighty-seven feet. The deep-sea thermometric apparatus was lowered, and water brought up from different depths. Temperature at 114 fathoms, 30·0; sp. gr. 1028; at 50 fathoms, temperature, 29·5; sp. gr. 1025; at 25 fathoms, temperature, 31·5; sp. gr.

1024; at surface, temperature, 38·0; sp. gr. 1023. After dinner Young and I went out in a boat, endeavouring to get to Browne's Islands; but they were so closely beset with ice and bergs that we could only get within one mile of them. Some seals were seen, but beyond rifle-shot. Whilst we were out, the glacier was groaning and cracking, and some bergs vibrating strongly; these noises continued the whole evening. Noticed the same appearance of surface-water to-day. After 6 P. M. captain commenced magnetic observations, whilst I dug a hole three feet deep in the berg to insert a thermometer, leaving it all night—the temperature of the fresh water on the berg which was freezing was 32·2. A light wind sprung up about 10 P. M. Two dovekies were shot. Ninety birds to-day. The sun is just now (midnight) dipping below the horizon.

"15th. This morning I took the thermometer out of the hole in berg, and found it 29·15; temperature of surface, 32·10; sp. gr. of sea water, 1025. This day was much the same as yesterday, but scarcely so pleasant, as the wind began to freshen; this was greatly in our favour, whilst it loosened the ice in places, and opened our way. Several seals were fired at, but none killed, as they were too far distant. Several mollymokes were shot, and kept for dogs' food. This morning has been rather cold, consequent on the wind off the glacier. We hope to move early in the morning.

"16th. This morning, at 6.30, we got under weigh, and cast off from the berg, the wind having opened a lead; during the day we made considerable progress. Divine service, as usual, held on the lower deck; all present but those necessary to work the ship. At 10 A. M. a seaman's chest was picked up, containing some lumber, most likely belonging to some of the nipped whalers. We have been passing through drifts and young ice all day; large bergs constantly around us. Numbers of seals were seen; one shot, and preserved for the dogs; a few mollymokes also were obtained, and the tracks of a bear seen on the snow. We continued steadily progressing, sometimes with favourable, other times with contrary, winds. The sun shone, and it was very pleasant in the forenoon, but in the afternoon and evening it became rather cold, and about 8 P. M. a thick fog set in; however, we continued our course for some time, until the fog prevented us taking advantage of any lead we might otherwise have seen, and we had to haul up several times on the edge of the floe. At 11 P. M. we got stuck fast in the ice, and anchored for the night. Cold, damp, and foggy.

"17th. We remained all night hooked on to the floe, the fog remaining thick the whole time till 10.15 A. M., when we backed out of our uncomfortable position by the aid of steam, and continued onwards by the most favourable lead, cutting through young ice and passing bergs in numbers, whilst occasionally we had a little snow and sometimes a favourable wind. In the afternoon, at 5 P. M., we were stopped by a small floe connecting two larger ones. We passed a short distance through this, but ultimately stopped; and although blasting tins filled with gunpowder were used, we were kept fast. Right under our bows were the recent tracks of a bear. A good fall of snow came on just as we

stopped. No further progress was made this evening. About 11 P. M Captain Young and I went out to shoot seals, and when we were returning I saw a bear about half a mile from us; we hastened to the ship to get more ammunition, and to acquaint the captain of the presence of the new arrival; and although we waited patiently till 10 A. M., he did not come within rifle shot, and then scampered away.

"18th. This day we have been shut up in the ice, no progress being made until evening. We have been tracking and warping the ship, and breaking up and pushing out of our way the ice, all to gain some open water about ninety yards ahead of us. Warping is very slow work. In the afternoon blasting tins were about to be used, but the ice opened a little, so as to allow piece after piece to be detached, and give a slight opening for the bows of the ship. All the officers and both watches were engaged in this work. At 9 P. M. we gained the water, and proceeded under a very slight wind until 11.45, when again we were stopped by the floe, and anchored for the night. Numbers of seals were seen during the day, and one was shot.

"19th. Early this morning two bears were seen, but they did not approach sufficiently near the ship to give any one a chance of hitting them. The water that we passed through last night is now almost completely filled with floe ice, so that we are completely surrounded, our farther progress at present being altogether impeded. We had numerous showers of snow to-day, and it was rather cold. Two seals were shot and preserved for the dogs, and one glaucous gull. In the evening the men turned out for a game of rounders,—the exertion kept us warm, although the air was cold. We are all very anxious to get out of Melville Bay, as the season is getting pretty far advanced.

"20th. Still fast in the ice, and no appearance of a lead, although a constant look-out is kept. Falls of snow continue, and we are thickly beset by ice; the air keeps cold, requiring us to exercise as much as possible. Captain Young shot one seal, and Petersen two. The men had another game of rounders this evening. No bears on tracks seen to-day. Nothing else of interest.

"21st. Still in the tight embrace of the ice.

"22nd. Still in the tight embrace of the ice.

"23rd. No movement in the floe. Divine service was held as usual. About 1 P. M. two narwhals were seen in a pool a little ahead of us, but before the whale-boat with the harpoon-gun could be got near them, they departed. To-day Cape Walker was very visible.

"24th. This day we have been towing and tacking, and warping and exploding, the result being two ships' lengths gained; some wind present, but not very favourable; the atmosphere peculiarly clear and refractive to-day, causing the bergs and the horizon to appear very fantastic, and the coast was very apparent for many miles, about fifty or sixty miles distant; all Melville Bay was very visible; not a bird was seen the whole day, and only a few seals; one was shot. The sky was very Italian in the afternoon, interspersed with cirro-stratus clouds, and the sun in the evening appeared of a roseate hue.

"25th. This morning we had to back out a little from the lead we were in, as it was closing by the action of the wind. The afternoon was employed in warping.

"27th. Yesterday was employed in warping; to-day the same. This morning, when working with the others, the piece I was on sank with my weight, and down I went, but providentially the boat was near, and I got in, nothing the worse, only the wetting. Captain Young afterwards, and the boatswain's mate, followed my example, so I was not alone. Stopped at dinner-time. At 6 P. M. again commenced warping, and continued until 1 A. M.; no use, still fast beset.

"28th. We still remain in the same place; nothing of importance occurred during the day; three seals shot; no motion in the ice; it looks rather like a winter in the floe.

"29th. To-day has been much the same as yesterday; no movement in the ice; we are indeed 'cribbed, cabined, and confined;' at present we could not move five yards ahead. The young ice prevented the appearance of seals, so there were none shot. I examined some of the seals shot yesterday, and preserved specimens. I found the foramen ovale completely closed, so that the length of time they can remain under water is not due, as some have supposed, to the permanent patency of this quondam foramen, but must depend on something else. Although the arterial blood was as red as could be expected, yet the muscles seemed very dark, and as if gorged with venous blood. The eye, when the animal was living, and immediately after death, seemed of a greenish hue, but half an hour afterwards it had a brown appearance. The recti muscles seemed strong and fleshy, and the lens quite circular, not oval. Two of those examined were females, measuring about 4 feet, 3 feet, 1 foot 6 inches; 110 lbs. in weight, their intestinal tract between 30 and 40 feet; receptaculum chyli, large, and plentifully supplied with blood-vessels, lacteals, and nerves, containing a large quantity of chyle. The stomach large, and consisting of two portions, full of small crustaceans, in different stages of digestion; the œsophagus entering immediately into the first stomach, no cul de sac being apparent; stomach contracted in the middle, thus divided into two; second stomach very thick in its coats. One animal had its brains knocked out by a rifle-ball, yet, ten minutes afterwards, its heart was pulsating in its thorax as I held it in my hand; their skulls are very thin. In the evening we had foot-races, running backward and forward; the men seemed all to enjoy themselves very much.

"30th. This morning divine service was held, as usual, in the forecastle. The barometer gave indications of a gale, which commenced after church, and still continues. The wind is now N. W., accompanied by a mist; we hope it may do us good, by opening the ice so as to allow us out of it; the air was keen and bracing on deck, but walking made it very pleasant.

"31st. The gale rather moderated towards morning, and is now over; we experienced a slight 'nip' at 5 A. M. The wind appears to have done us little good, only drifting us with the pack N. W. The wind has now veered to S. E. No better prospect of getting out of the Bay. No seals

were shot. Holmes and I went away in the evening to look for seals, taking a Halkett's boat with us, but after waiting patiently for some time, none appeared. A stove was put up in the steerage in the afternoon, making it very comfortable.

"September 1st. No new appearances to day; the ice still surrounding us, and no prospect of getting out, so we have all (almost) made up our minds to be content to lose a year, although this must be very trying, to the captain most especially, and to the expedition as a whole, incurring more expense, and keeping back the objects of the expedition for twelve months longer. One or two seals were shot to-day. Preparations are being made for the winter housing, and for stores on deck, and different parts of the ship. The sun presented a most remarkable appearance to-night as he sank beneath the horizon: a true grass-green ball, whilst the clouds immediately in the neighbourhood were of a deep golden hue.

"2nd. Ice, ice everywhere, and not a lead; different large pools of water appear in the distance ahead of us, but we are enclosed in the ice, and cannot get at them. At present the only good they are to us consists in their being places of 'resort' for the seals, three of which were shot to day. There is little wind, but a thick fog or mist enveloped us all day, and still continues. The evenings are getting short, and were it not for the snow, after 9 o'clock we could not see much around us. Three planets have been visible for the last two or three days.

"3rd. The 'barber' has been at work; the rigging and all on deck presented a curious sight this morning; there had been a sharp frost during the night, and the ropes were 'feathered' over with small crystalline plumes, about half an inch long, remaining all day. It has been rather cold to-day, but no fog, at least near us. One or two sledges have been lashed to day, and winter preparations are still going on. A slight Aurora was seen last night.

"4th. This morning there was a slight mist, so that the land could not be seen, and, as the sky was overcast, our true position could not be ascertained. Three seals were shot yesterday. To-day was comparatively cold. Dip observations were made last evening and this morning. Some snow during the day, and just now there is a slight fall. Day after day our small chance of escape gets smaller by degrees, and soon, I suppose, will be reduced to a nonentity. Two seals shot, and one black whale wounded. To-day I was engaged preparing iodide of potassium paper for ozone experiments; observations to be made every twelve hours,—9 A. M. and 9 P. M. To-morrow morning I commence.

"5th. To-day there has been very little mist, but the sky was overcast; the land was very plainly seen, especially in the evening. The ozone paper was put up, and satisfactory results obtained in the evening. The deep-sea lead and thermometer were lowered, and bottom was found in eighty-two fathoms; a bottle of the water was procured; observations were taken at different depths. The dredge was lowered, and plenty of mud, with granite, quartz, and gneiss pebbles, were obtained; also numerous animal specimens were found in spots; some mud also procured. Six seals were shot this evening. The presence of this mud bank had not been previously ascertained.

"6th. No sun to-day, except for a very short time in the afternoon; sky overcast and cloudy. There has been a slight fall of snow in the early part of the morning. The dredge and deep-sea line, which had been down all night to ascertain drift, was hauled up, and contents procured; it was again lowered in the afternoon. Divine service was held at 10.30 A. M.: all present. After dinner some of the men went out seal-shooting, and four were brought in; two black whales were seen. Since 6 o'clock the sky was cleared a little, and the sun set at 8.30., the moon occasionally visible; about ten bergs are to be seen from the mast-head; some are grounded on this bank. Nothing else of interest during the day. Early yesterday morning it was reported we had an addition of young dogs to our 'troupe,' four juveniles being apparent; they have all been eaten since by the other dogs.

"7th. Great hopes were raised in our breasts to-day by the appearance of several large pools of water close ahead of us, and operations were commenced with great vigour; the young ice around the ship was rather thick, so steam was got up, and it was broken up by paddling about. All hands were busily employed in breaking up and blowing up the ice close to us; all the time it was snowing rather briskly. This was continued until 9 o'clock, when we were separated from the pools by only about twenty yards of ice. We might get through this in the morning, but the winds are against us. The men worked with a will (as they always do), and great quantities of ice were displaced; it was rather unpleasant work out in the snow, but the prospect of getting away cheered us, and lent vigour to our arms. The wind is increasing.

"8th. Alas for our hopes! the open pools of last night are scarcely to be seen this morning, and we are surrounded by ice again, with no prospect of delivery at present. Our work had been useless, and we are still fast, but we must succumb to circumstances. The dredge yesterday and to-day yielded some things of interest; no birds or seals were seen, as there was a mist all day, and some snow.

"19th. Everything has now a monotonous aspect; the same daily routine, breakfast, ozonometer, walk, read; dinner, walk, read, siesta; tea, music, walk, read, ozone, read, write, hammock. Still fast to the floe, with no hope of escape; we have been making winter preparations, fitting the ship, fixing sails, rigging, and masts properly; building a couple of snow-houses, putting up a marine barometer; found, at low temperatures, the hygrometer was little, if any way, affected. Took temperature of different places in the ship. We have been drifting a good deal. To-day the men have been restoring the main hold; dredge used on several occasions; two or three good Crinoideæ were taken. A faint Aurora last night. Soundings taken at 79 fathoms, stony.

"October 6th. This day has been cold as yesterday, with little wind, the thermometer now being 3° F., with beautiful stars and moonlight; no clouds or aurora; much ozone this morning and evening. I was busy to-day copying out the barometer results for August, tabulating the daily and hourly means; to-morrow I intend to do September. The men were employed on board arranging ropes, &c.; and afterwards all the boats were hoisted out, and are now on the floe; the funnel of engine

lowered, and arrangements made for taking engine to pieces. One or two seals were seen to-day, but were too wary, so that they could not be approached. Our evenings are getting shorter, and our out-door games have ceased for the present. It is very pleasant to walk on deck, gazing at the stars, and wondering what friendly eyes are doing the same in 'Ould Ireland.' All is quiet now as I write, save the purr of the cat beside me, the sonorous vibration of some sleeper, and the solitary pit-pat of the quartermaster on deck. Outside all seems beautiful above; whilst below, the sparkling snow, the subdued light thrown by the moon on the ice, the dark outline of the 'Fox,' while the masts sparkle with myriad points of ice crystals, combined with a perfect stillness, and the quiet moon looking down on all, give a perfect Arctic picture.

"22nd. Rather fatigued, as I have been up all night. Yesterday was rather a fine day. Barometer commencing to fall; a little wind, combined with snow-drift; no sun, and only occasional stars. A flat island or some land was seen this morning; one usuk was seen by Christian; nothing of interest occurred during the day. A good deal of snow fell during the afternoon and evening. At 9 P. M. commenced taking hourly observations with strong ozone paper,—the wind freshening at same time, barometer falling, and the amount of snow-drift increasing. I employed myself during the night in copying out thermometric tables, and reading occasionally, varied by a short walk on deck, punctually hauling the box-door at the end of every hour. The wind increased till the morning, when it was up to 9. The wind continues still, but much abated, and there has been little drift during the day; the barometer is rising, and the thermometer keeps about 1°; the decks are very slippery. Very good results have been obtained from the observations, but I have not as yet tabulated them. Astral observations were made last night, but the sun was too obscure to-day. I saw a faint parhelia to-day, but it remained for only a few minutes, not giving one time to use the polariscope, as it had vanished ere I came on deck with the instrument. It feels very cold at present, and as I am quite ready for bed, I shall turn in.

"November 2nd. The air to-day has been rather cold, although the thermometer stood at 5° F. We have had no sun, so I suppose he has left us altogether. The moon was visible all day, at least when the clouds allowed her to be seen. The men have been engaged building a snow-house, and completed it by the afternoon. School was held as usual this evening, and as we were closing, we were all roused up by the cry of 'A bear—a bear close under our bows.' We turned out with our rifles, as we could get them. The dogs had by this time surrounded and bayed him, and by the time Petersen and Christian had reached him he had broken through the young ice, and was floundering in the water. They immediately fired, as also did young Hobs and the captain as they came up. After a little struggle, he was settled by the shot the captain fired; having to load as I ran, I came up too late to fire, although I saw all the sport. The moon was rather obscured by the clouds, and the bear was on all sides surrounded by dogs, so it was not easy to get a shot at him. After being got out of the water by a harpoon and boat-hooks, he

was hauled in triumph to the ship; the young ice could just bear us when he broke through. He measured 7 feet 3 inches from tip to tip. He was seen, chased, shot, skinned, and cut up, all within an hour and a half. I obtained a kidney for a specimen. The dogs were regaled with the entrails, which they polished off in a very short time. Only one of the dogs has been wounded by the bear's paws. Barometer, 29·86.

"30th. The scene apparent on going on deck after breakfast was splendid, and unlike anything I ever saw before. The subdued light of the moon thrown over such a vast expanse of ice, in the distance the loom of a berg, or the shadow of the hummocks (the Arctic hedge-rows), the only thing to break the even surface, a few stars peeping out, as if gazing in wonder at the spectacle,—all united to render the prospect striking, and lead one to contemplate the goodness and power of the Creator. I went out about 10 A.M. to get some ice for my experiments; the temperature was 26°, but the walk was most pleasant. There was no water seen to-day, except mere cracks, which, as soon as formed, were skimmed over with a thin coating of ice. The thermometer is now at 30°; barometer, 30·40. To-day there was a comparison made of thermometer with the Kerr standard. We had the moon shining all day, and a few stars at present; occultations of Jupiter's satellites were taken this morning, and observations for latitude 74° 41′ N. The men were employed on the floe, and in pumping out the ship. After school this evening I went out over the floe for a walk, about the most delicious I have had,—the moon pouring down a flood of light and glory so strong and clear that everything appeared bright and lovely; not a sound to be heard, save the crackling of the snow under my feet, of unsullied whiteness, and sparkling from innumerable points like a mass of diamonds; the hummocks especially appeared glittering from the presence of countless circular crystals, about an inch long, which stuck out like a miniature *chevaux-de-frise*, and formed lines of sparkling light; in fact, it is just such a sort of night as one would wish to wander the whole night long, and think, and dream, and yet not feel tired; but we must return to the ordinary toils and common details of life, although nature wears such an inviting aspect. My freezing experiments are going on, and will be continued during the week. The last day of the month, and thirty days since we have seen the sun, with no prospect of his appearance for sixty more.

"Christmas-day. My first from home, and first in the Arctic regions. I was greeted early in the morning with the usual compliments of the season. I rather astonished them at breakfast by my having on a white shirt and collar, the only one but one seen on board during the day. After breakfast the sky began to clear, as if we were going to have some daylight in honour of the occasion; but it only lasted a few minutes. At 10 mustered, and held Divine service on the lower deck, and afterwards the men proceeded to garnish the tables and deck the forecastle for dinner. At dinner-time the officers were invited forward to see them, when a sight met our eyes I could not have imagined. Sledge banners and bunting were gracefully grouped round the beams and sides; the place gaily lighted up, whilst the tables were loaded with innumerable

dishes of various sorts. Ham and pork, and beef soup, with apples, gooseberry juice, and jam-tarts, with a superabundance of currant cake, nuts, and cheese; the cook dressed in his white, whilst each of the messes had a steward arrayed to do honour to the occasion. 'A happy Christmas' and 'Lady Franklin' were proposed, and received with a sailor's good will; then the men sat down to dinner, pleased with themselves and everybody else; it was a cheering sight in the Arctic, and spoke volumes for the *materiel, morale,* and *personnel,* of the ship's company. They had an abundance of everything to make them comfortable and cheerful, whilst on each of the messes were placed photographs of absent ones, propped up by bonbons; so that, while enjoying themselves, others were not forgotten. The moon had risen about 11 A. M., having a long pencil of golden rays shooting vertically through her; she has remained ever since. Our own table was covered with all the delicacies of the season. Lady Franklin and absent ones were remembered in champagne. My ideas of an Arctic Christmas had fallen far short of this reality. We all were sorry at our inactive position at present, but look forward with pleasing anticipations to our next one, when our sledge banner will have become more valuable. The men are still enjoying themselves quietly singing and toasting. The officers went down for an hour or so. It would be utterly useless and endless in me to try to write what were my thoughts about home and friends. This one thing I am sure of—that they did not think oftener or with more loving wishes of me than I did of them. What would I not give for just one peep at home! One thing has struck me several times since I came out here. Mother said at the dinner-table last Christmas that she did not expect that we would all meet there this one. I wondered at it at the time, and I am sure so did the rest; but none of us dreamt of my being here; but now the prophecy is fulfilled. Well, considering all things, I have spent a very pleasant Christmas, and now good-night, and may we all be spared to spend the one after next at home around the family hearth!

"January 28, 1858. *Il ritorno del sole.* The long wished-for event occurred to-day at 11.25, mean time. I was the first to see the sun, being up in the crosstrees. The temperature to-day has varied from 35° to 40° ·5—the lowest we have had as yet. Thermometers were compared in the forenoon; barometer rising all day near 33·26; seven and a half hours' daylight. Many bergs are to be seen from the mast-head. Men are engaged building snow-houses. Very little wind to-day; about 1, rather southerly. The whole under-surface of the snow on the top of the floe is a mass of plesiomorphous crystals. I made some drawings of the forms. The ensign hoisted, and extra half-gill of grog issued in honour of the reappearance of the sun; sun absent eighty-nine days.

"Easter Monday, April 5. The past night, or rather morning, has been replete with incidents. The gale of yesterday had continued, when, at 2.20 A. M. the floes alongside cracked in a line with the ship, and we were set adrift. All hands were called on deck, and, amidst blinding drift and a cold squally gale, there was an ice anchor, with hawser and cable, got out, and the ship was secured head to wind to the starboard

or fixed floe; after this the quarter-deck housing was got down, not a minute too soon, as it would have been seriously damaged had it remained half an hour longer. The wind later in the morning decreased to eight, and is now nine. The deck was thickly covered with snow. At 8 A. M. the ice became stationary; the men were engaged in clearing up decks, &c. On the 16th and 17th of April the ice broke up around us, leaving a large lane of water to the sternward. On the 17th we were driven from the edge of the floe, leaving four or five dogs behind us, and with difficulty getting the boats which were on the floe on board. We made sail, and ran about twenty-five miles to the eastward, when we were again beset in the ice. We remained here until the 25th. A tremendous swell came up from the ocean to the southward, the effect of a south-east gale, which broke up the ice, and raising waves thirteen feet high. The pieces of ice were driven against the ship with terrific violence. Steam was made immediately, and also sail, and the ship was kept head to the swell; had it not been so, the ship's sides would have been battered in in a very short time. We continued from 2 A. M. on Sunday, the 25th, until 8 P. M., steaming, at which latter hour we had advanced twenty-eight miles, and at last found ourselves clear of the ice. So good-bye to it; and we set sail for Holsteinborg, and here I am. We reached this on the 28th. We leave, most likely, on the 7th."

[As we were going to press, we were favoured by Dr. Alfred H. M'Clintock with the subjoined letter, just received by him from his brother. The good news of progress contained in it affords some compensation for the disasters of the "Fox's" cruise last year.—Eds. Nat. Hist. Rev.]:—

"'*Fox*,' *near Cape Warrender, Lancaster Sound,*
12*th July*, 1858.

"My dear Alfred,—My last letter to you was written on the 3rd of June, at Uppernavik, and put on board a whaler ('Emma,' of Hull, Captain John Parker), together with a box of bird-skins, &c.

"We were fortunate enough to get through Melville Bay, and reach Cape York, by the 26th June, and there communicated with the natives. They told us that Kane's Esquimaux (Hans) was married, and living in Whale Sound, but was most anxious to get back to South Greenland. We only entered Lancaster Sound this morning, having met with an unusual quantity of ice when crossing from Cape York. Here we also met with natives (near Cape Horsburgh), but they could only give us the very unwelcome intelligence that Barrow Strait is still frozen over.

"17th July. The last bit of news I have written had a very disquieting effect upon me, I assure you. I do not accuse the natives of wilfully misstating anything; but I have been able to prove that they were wrong. We are now across Lancaster Sound, and off the entrance of Navy Board Inlet. All this sea is covered with loose, but broken-up, ice, which the first westerly wind will carry away. The summer appears to be a forward one, and I think our prospects are very fair. I am now bound for Pond's Bay, where I commence my search, for information

at least, as the Esquimaux there have doubtless heard reports from the more western tribes respecting the loss of the Franklin Expedition. I also expect to meet the whalers there, to obtain some further supplies from them, and give them our letters. I shall despatch two more cases of specimens to you. I think you had better not open them, as there are only a few birds' skins in one of the cases which can possibly spoil by keeping. They are filled with specimens of minerals, birds' eggs, and dredge specimens, in jars. We have met with an unusual quantity of ice since leaving Melville Bay; in fact, it has constantly been close about us, impeding our progress for the last six days. We have been in Lancaster Sound, advancing, upon the average, ten miles per day! whereas, in clear water, we could have averaged 100.

"Sunday, 18th July. Between Capes Hay and Liverpool, and drifting with the ice down towards Pond's Bay, very much as we did in the 'Enterprise;' lovely weather.

"19th July. . . . . . fortunately, watching over my little Expedition, and taking very frequent and anxious surveys of the surrounding ice from the Crow's Nest, afford me some occupation. I am careful to inform Lady Franklin and Captain Collinson of all my doings and intentions, so that they may see my cards, and judge of my chances of success, or otherwise, as well as if they were aboard the 'Fox.'

"24th July. Off Possession Bay. For a week we have been closely beset, and unable to move except with the ice, which was influenced by the winds and currents. Great was my surprise, when in this unhappy plight, to see, a few days ago, a fine steam whaler, which had got ahead of me in Melville Bay, struggling through the ice not many miles from me. This morning we have regained our freedom of action, and only lack the wind to proceed. The winds lately have been favourable for moving the ice out of Barrow Strait, so I have no fears for the future. We all continue in excellent health, and manage to vary our grub by shooting looms, rotchies, ducks, and seals. The latter we can manage to devour as well as any Esquimaux. Although we are but few in number, we have plenty of noise on board the 'Fox.' Our twenty-seven dogs howl and fight continually, and we shoot at everything we see. Two days ago Mr. Petersen shot an immense bear (8 ft. 3 in. in length), at 150 yards, with a Minie rifle; the bullet went through his body.

"26th July. Near Pond's Bay. We have found one whaler, and, as I fear we shall not see any others, and may not meet her again, I think it better to close this at once, in order to secure the opportunity. Should another occur, I will write to you the result of our doings at Pond's Bay. As yet, the ice and wind prevent our pushing on for it. It is probable that we shall meet with more than ordinary difficulties in Barrow Strait; but I trust we shall meet them in the right spirit, and, with God's blessing, be more successful in this our second attempt.

"Believe me ever affectionately yours,

"F. L. M'Clintock.

"P. S.—This letter and the two cases of specimens I have mentioned are to go to Hull, in the 'Diana,' Captain J. Gravill, who has kindly promised to take charge of them for me."

THE OMPHALOS CONTROVERSY.

We are bound to close the "Omphalos" controversy in the present Number of the Review; and in doing so we cannot regret that it has taken place, although it has certainly assumed a form we had not contemplated. Mr. Gosse has not performed his duty as a controversialist, but has written a supplement to his book, introducing additional and doubtful principles, and departing from the safe ground he occupied in "Omphalos." In doing so he has left us to feel the full force of Mr. Jukes's geological hammer, which has descended upon us with as little compunction as if we were a block of syenite; indeed, we found some difficulty in avoiding a second blow, as Mr. Gosse had given Mr. Jukes some reason for displeasure, by not noticing his letter, except in an incidental manner.

We shall now endeavour to state as briefly as possible our reasons for dissenting from the letters of both the combatants; and in doing so we ask their indulgence in case we fail to seize their meaning fully.

The following are the vicious syllogisms attributed by Mr. Jukes to Mr. Gosse; and inasmuch as we expressed the opinion, which we still hold, that the logic of "Omphalos" is exact, we feel bound to undertake the task, which properly belonged to Mr. Gosse, of showing that the defects of these syllogisms do not vitiate the reasoning of his book.

First Syllogism:—

Major. All organic beings bear in their structure evidences of previous stages of existence, or of a pre-existent parent, &c. &c.

Minor. The earth bears in its structure evidences of previous stages of existence.

Ergo. The earth is an organic being.

In this syllogism the middle term is taken twice particularly, being in both premises the predicate of an affirmative proposition; and therefore the syllogism is vicious.

We do not see how this reasoning affects the logic of "Omphalos." Mr. Gosse has not attempted to show that the earth is an organic being, and it is quite unnecessary to his argument to do so; of course, if he could show that it was so, his argument would be strengthened, as he would gain the probability of the earth's resembling other organic beings; but Mr. Gosse only seeks a *possibility*, which he can establish without entering into the question of the earth's being or not being organic.

We may observe, *en passant*, that the famous Kepler believed that the earth and planets were intelligent animals, swimming round the sun, and delighting to move so as to keep up the exact law of equable description of areas, and that they would be grieved beyond measure at the slightest deviation of the sun from the focus of their orbits.

The second vicious mode of reasoning attributed to "Omphalos" by Mr. Jukes is the following:—

Second Syllogism:—

Major. Every individual of an organic species bears within itself evidences of previous stages of existence, or of a pre-existent parent.

Minor. But in the first created individual of a species this evidence must have been false.

Ergo. The evidence of previous stages of existence which the earth bears within itself are false.

Mr. Jukes very properly rejects the above conclusion from the premises; but it appears to us that it is unfair to assert that Mr. Gosse ever drew such a conclusion at all. Let us throw the syllogism into a more exact form, and draw its just conclusion:—

Second Syllogism:—

Major. All individuals of an organic species bear within themselves evidences of previous stages of existence, &c. &c.

Minor. Some individuals of an organic species, viz., the first created, bear this evidence falsely.

Ergo.—Some things, bearing evidence falsely of previous stages of existence, do bear evidence of previous stages of existence.

The preceding conclusion (*Datisi*) is logically deduced from the premises, and, if we mistake not, is a conclusion arrived at abundantly in "Omphalos." The defect in the syllogism attributed by Mr. Jukes to Mr. Gosse is not in the premises, but in the deduction of the conclusion. The premises are valid according to the rules of Aristotle, and admit of having an exact conclusion drawn from them, viz., that it sometimes happens that evidence of previous stages of existence is not necessarily true evidence. This is the very conclusion aimed at all through the illustrations in "Omphalos," and is unquestionably true, provided the truth of the premises be granted.

Mr. Gosse adds to this true conclusion the *possible*, but improbable (as we think) hypothesis that the earth may resemble the first created individuals of organic species in this respect; and the *possibility* of this hypothesis must be granted to him, without supposing that he assumes, either that the earth is an animal, or that it is the first created of its kind.

Geology is no more exempt than are the other branches of human science from the control of logic; and although many geologists are in the habit of speaking and writing as if their ingenious conjectures were mathematically deduced from well-ascertained facts, it is high time that they should come down from their self-assumed position, and humbly submit themselves to the laws of thought that must always govern well-educated minds. We believe that Mr. Gosse has rendered to Geology an important service by recalling attention to the slippery basis on which even its fundamental assumptions rest.

As for Mr. Jukes's argument against "Omphalos," drawn from the supposition that it represents the Creator as a "deceiver," or, as other geologists have coarsely and profanely expressed it, a "humbug," we do not conceive that it has the slightest force in a logical point of view, though, of course, in estimating a question of mere probabilities, it comes in as of some value, in the same manner as the argument from final causes is used in natural theology. It signifies, however, but little in the present case, as it could be used, and was used, with equal force against Bishop Berkeley's denial of the existence of matter.

It is now an elementary theorem in metaphysical science, known to every tyro, that it is impossible to refute by logic the philosophical denial of the actual existence of matter, notwithstanding the furious opposition it received from the Scotchmen who modestly called themselves the common-sense philosophers. The subtle and polished lance of Berkeley pierced through the seven-fold bull-hides of Reid and his allies, although they were as unconscious of their defeat as they would have been incapable of understanding a joke; while the huge paving-stones, thrown after the manner of the geologists or homeric Heroes by the school of Reid, passed without injuring it, through the etherial shade of the immortal Berkeley, which, being devoid of matter, was incapable of hurt.

In like manner, we believe, that any man who possesses the requisite abstract turn of mind, may adopt and successfully defend, against all comers, the position laid down for the first time systematically in "Omphalos," viz. :—

It is impossible to prove the actual previous existence of the fossils found in the earth.

Mr. Gosse, in his letter, has attempted to place his theory on a firmer foundation, and in order to do so has called in the aid of a speculation which we have no doubt he believes to be one capable of proof from Holy Scripture, but which we think to be unscriptural and improbable in the highest degree. We feel called upon to point out very briefly the errors into which he has fallen. His position is, that suffering, death, are impossible, in a perfect government, except as the result of sin, or moral evil.

The inference from this position, of course, is, that nothing could have died on the earth before Adam sinned, as he is the federal head of the terrestrial creation; and, therefore, that geologists have erred in supposing that fossil shells, &c., actually lived and died. We wonder that the author of "Prochronism" should have urged this argument, as nothing is easier than to suppose that the Pterodactyle and Ichthyosaur died because Adam was to sin. To the mind of the Divine Architect there can be no past, present, or future; and He who willed the benefits of Christ's death to extend to those who lived and died before that event may easily be supposed to have introduced death, *metachronically*, into the world, because he foresaw the fall of man. Such, we believe, would be a ready answer to Mr. Gosse, on his own principles; but we entirely deny his hypothesis as to the origin of physical evil. Let us call his attention to the famous four-horned dilemma of Epicurus, to disprove the existence, or rather, superintending care, of the gods.

Hypoth.—Granted that evil is in the world, and ought not to be there.

1. The gods can, and will, remove it (*possunt et volunt*).
2. The gods can, and will not.
3. The gods will, and cannot.
4. The gods cannot, and will not.

From which it follows, in the four cases :—

1. Contrary to fact.
2. The gods are malevolent.
3. The gods are impotent.
4. The gods are both malevolent and impotent.

Therefore—There are no gods worth attending to or believing in.

Metaphysics are sharp-edged tools, and often wound the hand that uses them. If the dangerous hypothesis be granted, that the physical evil in the world is a mistake, and ought not to be there, it is difficult to avoid the force of Epicurus's denial of a Divine Providence. But if, as Mr. Gosse says, all death is the result of sin, and this doctrine be laid down in Scripture, the case is altered, and we will not yield to Mr. Gosse himself in readiness to bow to the decision of the highest authority we recognise on earth.

Mr. Gosse has completely failed in showing from Holy Scripture that death in the animal creation is the result of man's sin.

He admits that the passage quoted by him from the fifth chapter of Paul's Epistle to the Romans relates exclusively to man, who, as a moral and rational agent, is subjected to laws quite different from those which regulate the brutes that perish.

In the eighth chapter of the same Epistle we find the remarkable passage (verse 20) :—

"τῇ γὰρ ματαιότητι ἡ κτίσις ὑπετάγη, οὐχ ἑκοῦσα ἀλλὰ διὰ τὸν ὑποτάξαντα κ. τ. λ."

We agree with Mr. Gosse that ἡ κτίσις here signifies the whole creation, or at least all that portion of it that comes in contact with man's caprice and madness, and suffers therefrom; and we also admit that τὸν ὑποτάξαντα means Adam; but we do not at all admit that ματαιότητι (same Indo-Germanic root as our own "MAD") includes the natural death of the creature as part of its signification; and we contend that it must be restricted to the folly, caprice, madness, cruelty, and vice of man, to whom the creation is made subject; and who, in his fallen state, inflicts his cruelties and tortures on all subject to his power, whether man or beast.

We must leave it to the admirers of H. R. H. F. M. P. C. to answer Mr. Gosse's question respecting the slaughter of the stag by the royal hounds on Ascot Heath, as well as to account for the loss of life occasioned by royal *battues* of pheasants and other innocent birds. It must be admitted, however, that it is the lesser of two evils for the Royal Field Marshal to use his untarnished sword in dividing the jugular of a dying stag, rather than employ it in its more fitting occupation, the destruction of human life. Long may his H. R. H., accompanied by the chivalrous Phipps, expend his warlike zeal, and waste his powder and shot, among the stags of Ascot Heath and the red deer of Balmoral; and may we never live to see the woeful day on which he shall

be called on by a mistaken country to take the field against foreign foes at the head of the armies of England!

In conclusion, we would observe that the difference between "Omphalos" and the geologists is more apparent than real. They both assert two propositions; but each lays a particular stress on one, and slurs over the other. The two propositions in question are:—

1st. The actual previous existence of fossils cannot be proved by argument.

2nd. Our belief in their actual previous existence is absolutely irresistible.

Mr. Gosse lays stress on the first, and Mr. Jukes on the second, of these propositions, and each wishes to ignore the proposition of his antatonist. For our part, we believe both propositions to be true, although we admit there is some difficulty in giving both an equal prominence.

From intelligent quarrymen we have from time to time received the following various answers to our questions as to what the fossils were, and how they came to be found in the rock:—

1st. "They were placed there by Noah's Flood."

2nd. "He that made the quarry placed them in it."

3rd. "Everything was once alive, and how could they escape?"

4th. "They bored down into the rock, and it was wonderful how they got so far down."

The above are actual answers, and we commend them to Mr. Gosse's study, as throwing light on the obscure question as to our intuitive and instinctive beliefs respecting fossils.—Editors Nat. Hist. Rev.

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INDEX TO PROCEEDINGS OF SOCIETIES.

Page.
ACADEMY, Royal Irish, ordinary meetings, 42, 44, 96, 100, 106, 111, 120, 214, 222, 273
—— Election of members, ... 96, 106, 122, 205, 273
—— Donations to Museum, ... 43, 46, 110, 214
—— Members lost by death, ... 121
—— Election of officers, ... 122
Actinoida, list of Irish species of, ... 35
Address of Lord Talbot de Malahide, President of Dublin Geological Society, . . 72
—— of the President of the Royal Irish Academy, ... 222
—— of Royal Irish Academy to the Lord Lieutenant, ... 206
Ancient Irish deeds, on, ... 106
Andrews, W., notes on the fishes of the western coast of Ireland, and on the occurrence of the boar-fish, ... 188
Arklow Head, on the igneous rocks of, ... 17
Anorthite, analysis of, from Ural Mountains, ... 174
Archer, William, on a new genus and species of Desmidiaceæ, ... 234
—— supplementary list of Dublin Desmids, ... 257
—— on an unicellular alga, ... 258
Atmospheric pressure, annual variation of, in Gulf of St. Lawrence, ... 44

Bacon, Roger, on the Opus Majus of, ... 100
Baily, W. H., on a crustacean from the coal-measures, with some remarks on the genus Limulus, ... 168
Bate, C. Spence, F. L. S., on a new British Hippolyte, ... 51
—— on the genus Scorpionura, ... 202
Birmingham, John, on the junction of limestone, sandstone, and granite at Oughterard, ... 55
—— on the drift of West Galway and eastern parts of Mayo, ... 57
Bryum sanguineum, on a singular form of, ... 129
Burchall, Edwin, additions to Irish Lepidoptera, ... 53

Cambrian rocks, on organic remains in, ... 88
Capros aper, on its occurrence in Ireland, ... 188
Carte, A., A. M., M. B., on a fossil elephant's tooth from the Doab Canal, . . . 84
Cayley, G., on the theory of reciprocal surfaces, ... 111
Cinclus aquaticus, on the sub-aqueous habits of, ... 91
Clermont, Lord, on the capture of the mute swan, ... 90
Crozier, Lieutenant R., R. E., &c., catalogue of Lepidoptera collected in Chatham, 125

Deeds, ancient Irish, ... 106
Desmidiaceæ, on a new genus and species of, ... 234
—— supplemental list of Dublin, ... 257
Diatomaceæ collected in Powerscourt, catalogue of, ... 123
—— Dublin, catalogue of, ... 271

Page.
Dickie, George, M. D., on the teeth of Hyperoodon, ... 50
Dip-circle, determination of the intensity of the Earth's magnetic force by, ... 96
Doyle, J. B., on the Dodder plant, ... 201
Drennan, W., on an ancient Etruscan inscription, ... 273
Drift, on the, of West Galway and eastern parts of Mayo, ... 57
Dublin Natural History Society, accounts, ... 31
—— Anniversary meeting, ... 26
—— Election of members, ... 31, 90, 96, 188, 200
—— Election of officers, ... 32
—— Donations to Museum and Library, ... 35, 87
—— Ordinary meetings, ... 35, 87, 90, 175, 188, 192, 200
Dublin University Zoological and Botanical Association, anniversary meeting, . . 46
—— Election of members, ... 125, 131, 147
—— Ordinary meetings, ... 51, 123, 125, 131, 234, 264, 271
—— Election of officers, ... 51

Euomphalus, and its relations to Pleurotomaria and the Haliotidæ, ... 32
Eurynome aspera, on the habits of, and remarks on its zoe, ... 37

Fossil elephant's tooth from the Doab Canal, ... 84

Gages, Alphonse, on a mineral forming the cement of a boulder of conglomerate, . 153
—— on pseudomorphic Tremolite incrusted with carbonate of lime, ... 68
Geological Society of Dublin, anniversary meeting, ... 70
—— Election of members, ... 1, 16, 55, 148, 153
—— Elections of officers, ... 72
—— Ordinary meetings, ... 1, 15, 55, 148, 153, 166, 168
Griffith, Sir Richard, Bart., notes on the stratigraphical relations of the sedimentary rocks of the south of Ireland, ... 2
—— on the occurrence of a rare form of Posidonia Becheri, ... 155
Greene, Professor J. Reay, on the distribution of Actinoida, with a list of Irish species recorded, ... 35
—— on the genus Lucernaria, ... 131
—— Additions to Irish Fauna, ... 191
—— on the British species of genus Æquorea, ... 273
Grubb, T., exhibition of an improved microscope, ... 96

Harrison, Professor, death of, ... 264
Harvey, Professor W. H., on a new Hypocalymna, ... 264, 296
—— on a new form of fibro-cellular tissue, ... 125
—— on Greyia, a new genus, ... 265
Haughton, Rev. Professor, F. R. S., notes on cleavage by, ... 16
—— on the genus Euomphalus, and its relations to Pleurotomaria and Haliotidæ, 32
—— on alteration of the form of Posidonia by cleavage, ... 161
—— on reversed faults occurring in anticlinal folds with oblique axes, ... 164
—— Illustrations of fossil Flora, ... 264
Hippolyte Gordoni, a species new to science, ... 51
Hyperoodon Butzkopf, on its occurrence, ... 49
—— on the teeth of, ... 50

Ingram, John Kells, LL. D., on the Opus Majus of Roger Bacon, ... 100
Irish mosses, additions to, ... 129
—— Lepidoptera, additions to, ... 53
—— Flora and Fauna, additions to, ... 30

Jukes, J. Beete, F. R. S., on the igneous rocks of Arklow Head, ... 17

Page.
Kinahan, G. H., description of a starling roost, ... 94
Kinahan, Professor J. R., M. D., natural history notes on Cornwall and Devon, . 266
—— remarks on the zoe of Eurynome aspera, &c. 37
—— on the occurrence of a new Irish Pandalus, ... 40
—— on the sub-aqueous habits of the water ouzel, ... 91
—— on the organic relations of the Cambrian rocks of Bray and Howth, with notices of the more remarkable fossils, ... 148
—— on fossils from the marine drift of Bohernabreena, ... 167
—— on the distribution of ferns in Ireland, with a list of localities, ... 175
—— on the genera Philoscia, Itea, and Philougria, ... 194
—— on Oldhamia, ... 207
Kelly, William, M. D., on the annual variations of atmospheric pressure in Gulf of St. Lawrence, ... 44

Lepidoptera, additions to Irish list of, ... 53
—— collected in Chatham during summer of 1857, ... 125
Limestone magnesia, on the origin of, ... 171
Limulus, remarks on the genus, ... 168
Lloyd, Rev. Dr., determination of the intensity of the Earth's magnetic force in absolute measure by means of the dip-circle, ... 96
—— on an improved form of a theodolite magnetometer, ... 99
—— on the effects of a distant luminary, supposed magnetic, upon the diurnal movements of the magnetic needle, ... 117
Lucernaria, notes on the genus, ... 131

Magnetic force of the earth, determination of, ... 96
—— needle, effects of a distant luminary upon the diurnal movements of, . . . 117
Magnetometer theodolite, on an improved form of, ... 99
Magnets, electro, on their lifting powers, ... 42
Mineral forming the cement of a boulder of conglomerate, ... 153
Moderatorships in Natural and Experimental Science, ... 47
Molecular constitution of matter, ... 210
Molony, Captain Charles P., on the origin of magnesian limestone, ... 171
Montgomery, Robert John, on the habits of the starling, ... 88
Moore, David, on the occurrence of a singularly metamorphosed form of Bryum sanguineum, ... 129
—— on additions to the Irish mosses, ... 129
Myrtle, on a new, ... 296

Natural history notes in Devon and Cornwall, ... 266

O'Meara, Rev. Eugene, A. M., on organic remains in the Cambrian rocks, . . . 88
—— Catalogue of Diatomaceæ collected in Powerscourt, ... 123
—— on the occurrence of antherozoids in Pleurosigma, ... 192
—— Contributions towards a catalogue of Dublin Diatomaceæ, ... 271
Opus majus of Roger Bacon, ... 100
Oughterard, junction of limestone, sandstone, and granite at, ... 55
Oxen, on ancient Irish, ... 276

Pandalus leptorhynchus, a species new to science, ... 40, 205
Patterson, Robert, M. R. I. A., on the occurrence of Hyperoodon Butzkopf, . . . 49
Polyzoa, on new genera and species of, ... 134
Posidonia, alteration of the form of, by cleavage, ... 161
—— Becheri in calp of Dublin, ... 155
—— lateralis in carboniferous slate, Kinsale, ... 160

Page.
Reciprocal surfaces, on the theory of, ... 111
Report of Council of the Royal Irish Academy, ... 120
—— Geological Society for 1856–57, ... 70
—— Dublin Natural History Society for 1856–57, ... 26
Robinson, Rev. Dr. Romney, on the lifting powers of electro-magnets, ... 42

Scorpionura, on the genus, ... 202
Scott, R. H., A. B., analysis of Anorthite, ... 174
Stanley, P., on the bogs of Tullamore, ... 152
Starling, on the habits of, ... 88
—— roost at Rathkeale, description of, ... 94
Steropis arcuatus, a species new to science, ... 168
Stoney, George J., on the molecular constitution of matter, ... 210
Stratigraphical relations of the rocks of the south of Ireland, ... 2
Swan, mute, on the capture of, ... 90

Thomson, Professor Wyville, on new genera and species of Polyzoa, ... 134
Tombs, on the contents of ancient, ... 214
Todd, Rev. Dr., on ancient Irish deeds, ... 106
—— on the contents of ancient Irish tombs, ... 214
Tremolite, on pseudomorphic, incrusted with carbonate of lime, ... 68

Ural Mountains, anorthite from, ... 174

Vaunthompsonia, a new genus, ... 202

Williams, R. P., on a variety of Mus sylvaticus, ... 188
Wright, Dr. E. Percival, Notes on Dr. Harvey's collection of zoology in Fiji, &c. 134
—— on a new species of Bunodes, ... 264
—— Entomological notes, ... 271
Wilde, William R., on ancient Irish oxen, ... 276

Zoe of Eurynome aspera, remarks on, ... 37

THE

NATURAL HISTORY REVIEW

AND

QUARTERLY JOURNAL OF SCIENCE.

Proceedings of Societies.

GEOLOGICAL SOCIETY OF DUBLIN.

WEDNESDAY EVENING, NOVEMBER 11, 1857.

E. Wright, LL. D., in the Chair.

Minutes of last Meeting read and confirmed. Donations announced, and thanks voted.

The following gentlemen were proposed and seconded, and admitted as Members:—

John Ball Greene, Esq. (Resident Life Member), 108, Lower Bagot-street: proposed by Rev. Professor Haughton; seconded by Dr. Whitty.

John Hancock Haughton, Esq., Carlow (Non-resident Life Member): proposed by Rev. Professor Haughton; seconded by Professor Downing.

William Porter, Esq., B. A., 13, Charlemont Mall: proposed by Rev. Professor Haughton; seconded by Dr. Whitty.

Alexander Carte, Esq., M. D., Director of the Museum, Royal Dublin Society: proposed by Rev. Professor Haughton; seconded by F. J. Sidney, LL. D.

The proposed changes suggested by the Council in the By-Laws were then laid before the Society, viz.:—

Section III.—Paragraphs 1 and 2 to be replaced by the following:—

"1. The sum to be paid by each Member on admission, including his first year's subscription, shall be, at his option, £2 or £5.

"2. If an admission fee of £2 be paid, the annual subscription is £1;

and if an admission fee of £5 be paid, the annual subscribtion is 10*s*. In each case the subscription becomes due on the 1st of January, and shall be paid in advance."

That in paragraphs 4 and 5, the words "one calendar month" be altered into "sixty-three days."

That paragraph 6 be replaced by the following:—

"Any person who shall have become a non-resident Life Member by payment of the sum of £5, as above, shall, if he at any time reside within twenty miles of Dublin for more than sixty-three days in any one year, cease to be a Member, unless he shall either pay an additional composition of £5, or shall pay a Subscription of 10*s*. for each year in which he shall so reside for more than sixty-three days."

Dr. Griffith being absent, his Paper, of which the following is the title, was read by Professor Haughton:—

NOTES ON THE STRATIGRAPHICAL RELATIONS OF THE SEDIMENTARY ROCKS OF THE SOUTH OF IRELAND; WITH SPECIAL REFERENCE TO THE POSITION OF THE STRATA OF WHICH THE GLENGARRIFF AND DINGLE DISTRICTS ARE COMPOSED, IN COMPARISON WITH CERTAIN DOUBTFUL CLASSES OF ROCKS IN THE NORTH OF IRELAND. BY RICHARD GRIFFITH, LL. D., F. G. S. LONDON AND DUBLIN.

In preparing the several editions of my Geological Map of Ireland, including the last, I have found great difficulty in deciding on the class of rocks to which several extensive districts, situate in different localities in the country, ought to be attached. These districts are chiefly composed of brown and reddish-brown grits and conglomerates, some of which are quartzose, and some porphyritic, and these rocks are occasionally interstratified with gray and greenish-gray chloritic grits, alternating with purplish and brownish-red shales, and in a few instances with reddish limestone and with purple slates, having a regular cleavage in the south.

The most northern district consisting of these rocks occupies an extensive area in the counties of Tyrone and Fermanagh, extending in a south-western direction from the neighbourhood of Pomeroy in the county of Tyrone, to the north-eastern boundary of Lough Erne in the county of Fermanagh, and in a northern and southern direction from the town of Omagh to the village of Ballygawley, in the county of Tyrone, comprehending an area altogether of about 300 square miles.

The second district belonging to this series of rocks is situate in the counties of Roscommon, Sligo, and Mayo, where it forms a ridge of hills known by the name of the Curlew Mountains, forming a range of about thirty-two miles in length, the character of the strata being identical with those of the district situate to the north-east of Lough Erne, already mentioned.

The third district, composed chiefly of reddish-brown grits, is situate in the county of Mayo, and extends in an eastern and western direction from Lough Conn, along the north shore of Clew Bay, nearly to Achill

Island, and in a northern and southern direction from the neighbourhood of Castlebar on the south, by the Croaghmoyle Mountains, to the base of the quartzose mountain of Nephin on the north.

These three districts comprehend the localities in which this doubtful class of rocks occurs in the north and north-west of Ireland (and I may here mention another district containing them, situate to the west of Lough Mask, in the counties of Galway and Mayo, which extends to the mouth of Killary Harbour); but in the south they occupy a very extensive district, comprehending the south-western portion of the counties of Cork and Kerry, and particularly the peninsula of Dingle. This latter district has been examined within the last three years with great care by the gentlemen employed on the Geological Survey of Ireland, under the direction of my friend Mr. Jukes, and it is chiefly on the result of my own previous examination of this district, combined with the general information obtained from him, that I am induced to introduce this matter for discussion in the Geological Society, in the expectation that such discussion may eventually lead to a final decision in regard to the difficulty of the question at issue, and thereby enable me, if necessary, to correct the colouring and the lettering which indicate particular classes of rock on my Geological Map of Ireland.

At the Meeting of the British Association of this year, held in Dublin, I brought this subject, in conjunction with Mr. Jukes, before the Geological Section, and in a paper which I communicated at the Meeting of 1843, held in Cork, I entered at some length on the discussion of the class of rocks to which the reddish-brown sandstone district, situate to the north-east of Lough Erne, should belong; and I then generally described their unconformity with the red and gray sandstones which form the base of the Carboniferous series, and also their apparent conformity with the strata of the two small Silurian districts in the neighbourhood of Pomeroy and Lisbellaw. I also stated the probability of these brownish-red rocks being Silurian, from the analogy subsisting between them in the three districts I have mentioned, in two of which we find fossils of Silurian age. At the same Meeting, in a communication on the lower Carboniferous rocks, I pointed out that at Lisnarrick the Calp rests unconformably on the brownish-red conglomerates, while on the east and south the latter appeared to conform to the Silurian strata; and I observed that the red colour can no longer be considered a test of age, as it had been shown that red beds rested on undoubted Carboniferous rocks.

From the foregoing it would appear that from an early period I was inclined to connect these conformable brownish-red sandstones and conglomerates with the Silurian system, rather than to allot them a separate place; but, owing to the deficiency of our knowledge as to the real relations of the rocks termed Devonian, and the possibility, from the fact of their overlying the Silurian, that these rocks might be of that age, I was induced to place them provisionally in the Devonian system, at the same time distinguishing them from the Red Sandstones and

Conglomerates, which would occupy an unconformable and superior position, by a note to that effect on my Geological Map. I may also observe, that their unconformity with the overlying red and carboniferous beds was noticed at the same early period, though, in conformity with the established ideas which have grown with our growth, I did not make the sacrilegious attempt, either at that time or since, of uniting the brownish-red beds with the Silurian series on the one hand, or, on the other, of neglecting the distinction between the inferior conformable red strata and the undoubted Carboniferous rocks of the north of Ireland.

At the Meeting of the British Association held in Belfast, in the year 1852, I brought forward a communication relative to the Yellow Sandstone as developed on the north shore of the county of Mayo; exhibiting at the same time a complete suite of Carboniferous fossils, which had been collected from these rocks; and I remember having been much impressed by the remarks of Sir H. de la Beche and Mr. Jukes, who had visited that locality immediately prior to the Meeting. They advised me to omit from my Map a district I had marked as Old Red Sandstone, saying that by so doing I would strengthen the case of the Yellow Sandstone; as that, from their observation of that locality, it would not appear that any true Old Red Sandstone existed, and accordingly I had expunged my boundary and letter F. But as it would have become necessary to extend this generalization all over the north of Ireland, and not being in a position of doing so, owing to my inability at the time of making a personal examination, I afterwards thought it better to let it remain on the Map for the present: subsequently, however, examinations made by myself, and others connected with me, under my direction, brought to light Carboniferous plants, and even Mollusca, far below the boundary I had originally drawn, in black shales, gray sandstones, and conglomerates, so that I became convinced that there was a very slight development, if any, of the true Old Red Sandstone in the north of Ireland. I may allude to the occurrence of such plants as Sigillaria, with ferns, and *Stigmaria ficoïdes*, discovered within the boundary of these Old Red beds, as laid down on my Map, particularly at Mac Swine's Bay, situate on the north shore of the Bay of Donegal, amongst which I would call attention to the remarkable Stigmaria now in the courtyard of the Royal Dublin Society. These plants were declared to be Carboniferous by M. Adolphe Brongniart, to whom some of them were sent, and his letter on the subject may be seen in a late Number of the Journal of our Proceedings. On the north coast of Mayo, likewise, the same plants occur, mingled with Mollusca and fish remains, and are found very low down in the series, in the yellow, and even red shales at Glenbehy River, as well as in the shales and arenaceous limestones of Bunnatrahir Bay and Carrowcor. This being the case, it would appear that most, if not all, of the red beds of the north of Ireland, should be classed with the Carboniferous system, both from their conformability and their fossils; while their unconformability with the brownish-red grits and conglomerates of the three districts I have mentioned, sufficiently separates them from being

confounded with these rocks. With what series these brownish-red grits should be classed, is a question that I trust the present discussion may determine. But in the remarks that I shall have to make on the south of Ireland, I hope I shall be able to show a series of analogous lithological equivalents, which may contribute to a satisfactory settlement in regard to the system with which they ought to be classed. I shall not enter more at length, at present, into the question relative to the northern rocks, further than to remark that there exists sufficient similarity between the three districts I have mentioned, to justify a comparison. But I shall now proceed to advert to the rocks, of which the south of Ireland is composed.

It will be seen by reference to my Geological Map, that the Old Red Sandstone strata, as distinguished in that Map both by colour and the letter F, consisting of alternating beds of red and green shales, red sandstones and conglomerates, have an extensive range in the southern counties, pervading portions of Kilkenny, Waterford, Limerick, Cork, and Kerry, as well as Clare and Tipperary. Commencing in the counties of Kilkenny and Waterford, and extending more or less continuously in an east and west direction through the counties of Tipperary, Limerick, and Cork,—we find the Old Red Sandstone strata lying conformably beneath the Lower Limestone, and Yellow Sandstone of the Carboniferous system, and resting upon the upturned edges of the Silurian rocks in an unconformable position, till, reaching the Old Red strata in the county of Kerry, they are found preserving the same relative positions, passing through Slievemish and Caherconree, to the brownish-red, and greenish-gray grits, and the red, green, and purple clay slates of the Dingle district, which conform to and overlie the fossiliferous Silurian rocks of Ferriter's Cove, these being again overlaid unconformably on the western shore at Sybil Head by the beds of the Old Red series.

No difficulty hence arises in regard to the position of the Old Red series in the south of Ireland, it having been clearly ascertained to conform to the Carboniferous strata above, while resting unconformably upon the Silurian series beneath. The only question that will arise regarding it is, as to what system it will of right belong. And here I must enter upon an explanation of the principle of subdivision by which I have been hitherto influenced. Finding, in the course of my geological researches, that certain rocks below the lowest beds of the lower Carboniferous Limestone conformed to them, and contained the same fossils, I was led to add them to the Carboniferous system, the boundary at the base of the Mountain Limestone, as it had until then been termed, being found to be far too limited. These lower rocks I was ultimately led to consider as divisible into two groups, the upper of which I proposed to call Carboniferous Slate, and the lower, Yellow Sandstone. In respect to this latter and lower of the two series, it became a question as to where the line of division between them and the red beds lying conformably beneath should be drawn; and the discovery of certain plants, apparently of a Carboniferous type, and at present known as

Sphenopteris Hibernica, Lepidodendron minutum and *Griffithii* (the last of which was discovered by Dr. Carte in the course of the last year), led to the adoption of the lines of boundary which have been published on the last, as well as on previous editions of my Geological Map.

Subsequently, through the researches of my friends, Professors Haughton and Jukes, as well as those of myself, imperfect casts of these plants were found very far beneath the boundary which I had originally adopted, and hence the extent of the district which I had allotted to these lower Carboniferous rocks will be found much too circumscribed. The principle, however, upon which I set out, remains intact, and as often contended for, both by Professor Haughton and myself, in numerous papers, I would again say, that the base of the Carboniferous system will extend to any zone of these plants, no matter at what depth, or in connexion with what rocks soever, found. That this may have the effect of sweeping the whole of the fish beds of Scotland,* with the similar rocks of Glamorganshire in Wales, hitherto considered to be Devonian, into the Carboniferous system, I am not prepared to deny, as it is only a natural inference from the principle which I have laid down. It is true that I have preserved the established territories of the Old Red Sandstone on my Map, curtailing it only of the Plant or Yellow Sandstone beds, as I was not prepared to risk a controversy, merely upon the grounds of the well-known conformity between the two series, without a sufficiency of fossil evidence,—statements founded upon hypothesis, no matter how well grounded soever they may appear, but upon less than indisputable scientific principles, being still open to the charge of being mere speculation or guess; and especially as I found that up to the present time it has been as much as I could do to defend the innovations which I had already made, even though the Irish geologists generally, and especially Mr. Haughton and Mr. Jukes, who, I trust, will favour us with their views, have all arrived at similar conclusions.

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* *Note added in the Press.*—R. G.—These Scotch beds would appear to be rather high in the series, from the discovery of *Sphenopteris Hibernica* in them by Professor E. Forbes, with which we have Fenestella associated at the Roughty River and Tallow Bridge; and, as remarked Mr. Jukes and Mr. Salter, this plant is accompanied by undoubted Carboniferous Mollusca in the strata known as the Coomhola Grits; but I wish to guard myself strongly against the mistake of its being supposed that I intend to make dogmatic assertions relative to the lower non-fossiliferous beds of the true Old Red Sandstone. On the contrary, I agree with the opinion so frequently and so well expressed by Professor Haughton, namely, that in considerable thicknesses of doubtful strata, without the guide of fossils, it becomes comparatively a matter of indifference as to the series with which we classify them, provided that they are sufficiently distinguished for recognition by any convenient term generally agreed upon.

I find this remark to be the more necessary, as, at the last Meeting of the British Association, held in Dublin, Colonel Portlock had fallen into a mistake of this kind; and subsequently, my friend Mr. Jukes, in his "Manual of Geology," page 436, has, by a similar oversight, ascribed to me a share in opinions of which I am wholly unconscious.

No means that could have been adopted to ascertain the age of these plants have been neglected; and besides the attention paid to their examination by Professor Haughton, I have consulted M. Adolphe Brongniart, as already mentioned, whose opinion may be seen in a translation of a letter which I lately communicated at one of the Scientific Meetings of the Royal Dublin Society. I may observe, that as I was not looking for plants with a view of including the Old Red Sandstone within my line of boundary, I did not originally discover them so low down as my friend Mr. Jukes has since done; besides, that colour being the order of the day, I limited my researches mainly to the yellow beds, discontinuing my search upon reaching the underlying red beds. But I shall be ever ready to hear with pleasure of their discovery to the very bottom of these rocks, and to recognise them, with Mr. Jukes' and Mr. Haughton's concurrence, on my Geological Map, as a group of the Carboniferous system. I may here observe, that I do not wish to be understood as aiming at a subversion of the Devonian system, whether occurring in Devonshire or elsewhere, my present observations being strictly limited to the Old Red Sandstone of the south of Ireland.

The thickness of this series of strata in the south of Ireland may be estimated from a consideration of a few typical sections. Thus, at Ballyvoil Head, looking towards Dungarvan, the strata dip at a steep angle nearly vertical, towards the south-west, and we have the whole thickness exhibited from the Silurian to the Yellow Sandstone, which is about 2500 feet. Again, the Glasha River, near the boundary of the county of Waterford, affords a very characteristic section exhibiting the thickness of these rocks. The strata in this locality dip nearly due north, at an average angle of say 50°, giving a thickness of about 3200 feet. We have also, at Coolnamuck Bridge, south of the river Suir, in the same county, where the rock dips north at an angle of about 80°, a section which exhibits a thickness of gray and red Sandstone and Conglomerate with red shale of about 2500 feet. In some places the thickness may attain a maximum of about 5000 feet. But this seems excessive as an average. The thickness of the Yellow Sandstone will be about 800 feet, so that we may assume the average thickness of the two series to be about 3000 feet. In regard to this estimation of thickness, my friend Professor Jukes has kindly lent me his assistance in corroborating these statements. It will be understood that these thicknesses only apply in the case of a perfect development of this series of rocks, as in many cases they will be found to attain nothing like such an estimation.

I may now exhibit a section* which I have lately prepared with great care, the horizontal scale being 6 inches to a mile, and the vertical 880 feet to an inch, in which the whole structure of the south of Ireland may be seen. In this the granite of the Blackstairs Mountain, and the Hill of Brandon, respectively 2400 and 1600 feet above the

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* See Plate V.

level of the sea, with two outliers of the same rock (for one of which I am indebted to the observations of Mr. Jukes), will be observed to support disturbed strata of the Silurian series of the Inistioge district, through which the River Nore takes a south-east course. These beds are a portion of the great Silurian district which occupies the south-east of Ireland, and are overlaid in an unconformable position by the Red Sandstone formation, extending from the barony of Knocktopher, in the county of Kilkenny, to the city of Waterford on the south, and to Slievenaman on the west. Continuing the line of section from Knocktopher in a western direction, we find the same Red Sandstone resting in a similar position on an outlier of Silurian, also much disturbed, which constitutes the mass of the Welsh mountains; but it is to be regretted that in the line of section which I have necessarily adopted, we have mostly to run in the strike of the Silurians, thus rendering a display of their true dip and unconformity less striking than it would otherwise have been. Proceeding still to the westward beyond Slievenaman, we find the Yellow Sandstone, being a continuation of the band containing the plants, especially *Sphenopteris Hibernica* with *Anodon Jukesii*—which, extending from Jerpoint by Ballyhale and Kiltorcan, skirts the margin of nearly the whole of the Old Red Sandstone districts of the south of Ireland. We find, I say, the Yellow Sandstone conforming to the Red Sandstone beneath, and to the Lower Limestone above, which is again succeeded in a conformable position by the Upper or Splintery Limestone, and the Coal or Culm beds, which occupy the basin to the north-west of Clonmel, and proceeding still westward by the Lower Limestone, Yellow Sandstone, Old Red Sandstone, and Silurian strata of the Galty Mountains, and passing through the Old Red Sandstone, which reposes on the Silurian strata last mentioned at its western side, we again find the Yellow Sandstone, the Lower Limestone, and the Upper Limestone regularly succeeding in the neighbourhood to the south of the town of Charleville, in the county of Cork, till we reach the great culm or anthracite district of the counties of Cork, Limerick, Clare, and Kerry, known by the name of the Munster Coal District, where a succession similar to that which I have already described will be observed. These Coal strata rest conformably on the Upper Limestone at Liscarroll, in the county of Cork, which latter again appears in an insulated elevation, situate in the interior of the anthracite district at the Taur Mountain, which rises to a height of 1300 feet above the level of the sea; the general strike of these rocks being east and west, dipping north and south at an average angle of, say, 20°. The Coal strata undulate according to the numerous convolutions prevailing in that district, and as we proceed westward to the town of Castleisland, the Upper Limestone, as at Taur and Liscarroll, similarly underlying the western edge of the culm beds, is again repeated, the descending and conformable series consisting of the Lower Limestone, the Carboniferous Slate, or Lower Limestone Shale, which latter is characterized by a profusion of well-preserved and typical Lower Carboniferous fossils at Currans, and this again rests upon the Yellow Sandstone which overlies the Old Red Sandstone of the Slievemish, Caherconree, and Castlegregory

districts. And here I may observe that we arrive at the point which will be found to be the commencement of our difficulties; and I propose to limit the observations I shall have to make in the remainder of the present communication to a statement respecting the relations of the rocks of the Dingle Peninsula, and to a comparison of those rocks with the strata which comprise the district south of the town of Killorglin and Dingle Bay, extending as far south as the valley of Kenmare; and I shall conclude by an endeavour to show that an analog yexists between the brownish-red grits of the north of Ireland, to which I have already alluded, and certain strata of the southern districts to which I shall presently advert; hoping that by such a comparison I may be able to contribute towards a removal of the difficulties with which the subject is at present surrounded.

The district of the peninsula of Dingle may be said to contain three principal classes of rocks, the first of which is the undoubted Old Red Sandstone, similar to that of Waterford, Tipperary, and Kilkenny, to which I have just referred. These strata consist of alternating beds of red conglomerate, red and gray sandstones, with reddish and greenish shales, and they rest at various inclinations on the edges of vertical and much disturbed strata, the classification of which latter presents the difficulty with which we have to contend. I may mention a few localities where the clearest unconformable junctions between these two series of rocks occur. We have them clearly exhibited north of Castlemaine Harbour; also at Beenoskee, in the precipice over a lake on the east side; and at Carrignaspaniagh, which is the continuation of the Cahirconree range; and again, to the south of Brandon Bay; so that, in a section extending from thence in a south-eastern direction, we have four repetitions of unconformable junction across the peninsula. In the face of the mountain of Caherconree another remarkable unconformable junction may be observed, the underlying vertical strata presenting zig-zag flexures, probably the evidence remaining of some prior movement. I have prepared a section* at right angles to the former, running nearly north and south across the promontory, from Tralee Bay to Castlemaine Harbour, in which some of the unconformable junctions are exhibited, and they will be found to be indisputable. At Kinard, about 700 feet above the level of the sea, east of Dingle Harbour, we have an outlier of nearly horizontal beds of Old Red Sandstone resting unconformably upon vertical beds of brownish-red conglomerate, and occasionally red slate; and at Sybil Head, on the western shore of the peninsula, we meet a similar junction. Continuing across Smerwick Harbour, from Dunurlin Head to Ballydavid Head, and thence to Brandon Head, we find the same unconformities presented as at Sybil Head, as well as south of Toompaun Mountain, near Brandon Head, where at Pierasmore, two small outliers rest unconformably, and nearly horizontally, on the greenish-gray and brownish-red conglomerate and slates of Brandon Mountain.

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* See Plate V.

The invariability of these junctions between the two series leaves no room for doubt as to the age and position of the uppermost of the two, which everywhere, as in the valley of Tralee, and at the southern side in the valley of Castlemaine, conforms to the overlying Carboniferous strata.

We have now arrived at the question relative to the second class of vertical and much disturbed beds of the Dingle promontory, which immediately underlie the Old Red Sandstone, there quietly reposing on them? That they are not Old Red we have seen. Then, are they Devonian or Silurian? Not the former, certainly, if we adhere to the idea at present suggested by that term, such a violent application of it requiring an entire change of signification, it having been hitherto considered to be synonymous with Old Red Sandstone. Mr. Jukes has proposed that they should be recognised as the "Glengarriff Grits," a term of which I highly approve, as indicating their complete identity with the rocks of the Glengarriff district, to which I shall presently refer.

I need not here enter into the consideration of some local difficulties connected with certain rocks with which these Glengarriff beds are associated, such as the black slates of Annascall, as I await with pleasure to hear from my friend Mr. Jukes, who has fully examined them, the opinion he has formed. I shall confine myself to explain the grounds upon which I have classed them in my Geological Map, and it will be seen by reference to that document that I have been aware from the commencement of the question that might be raised, from an anticipatory note which I have appended on the margin, in which the pith of the considerations by which I was influenced is stated.

The Glengarriff grits in the Dingle district consist of reddish-brown, and greenish indurated sandstones, alternating with red, brownish, and purple slate, and reddish-brown slaty conglomerate, and they are identical with the strata which occupy the most part of the two remarkable promontories which lie between the bays of Dingle and Bantry, and which extend in a north-east and south-west direction from the western shores of these promontories respectively, until they unite about twelve miles north-east of Kenmare, and continue inland still to the north-east, terminating at Mount Hilary and the Boghra Mountains.

In tracing the line of section from the great Silurian district of the south-east of Ireland, through the Silurian outliers of the Welsh and Galty Mountains (or, making a detour to the Silurian and Old Red Sandstone rocks of the barony of Upperthird, and the Knockmeildown Mountains, in the county of Waterford), in passing to the boundary of the Glengarriff grits of Dingle, no change of relative position will be observed in the whole line, the Silurian invariably underlying the Old Red Sandstone unconformably, in vertical and contorted strata; and, seeing that the Old Red rocks of Dingle, in continuation, for a distance of 160 miles, and identical, as I have already mentioned, with those of Kilkenny, Waterford, Cork, and Limerick, occupy a similar position in regard to the Glengarriff grits, also in contorted and vertical beds: it appeared to me at the time, that they must form a portion of the one great

range of the Silurian rocks, which extend continuously in patches from shore to shore, east and west across the island. These grits might be higher or lower in the series, a point I did not venture absolutely to determine, though I considered them to be of more recent origin than the schistose rocks which lie to the east of the country, but still a portion, one and indivisible, of a lengthened and continuous sequence. Upon further examination however, finding them to be, as I believed, conformable with the undoubted Silurian strata, which extend south-west from Smerwick Harbour to the Blasket Islands, these strata being now considered to be of Wenlock and Ludlow age, as I am informed by Mr. Jukes; and independently at another point finding them to conform to a small outlier of Silurian which occurs on the south coast of the peninsula at Coosatorig,—I felt that I had such a corroboration of the conclusion at which I had gradually been arriving, that I had no further hesitation in at once laying down the Glengarriff grits on my Map as belonging to the Silurian system, whether the same consisted of an upper or a lower series; and as the unconformity between the upper and lower Silurian (the latter of which Mr. Jukes proposes to call Cambro-Silurian), as existing elsewhere, does not appear to me to affect the question relative to the position of the Glengarriff grits, which are associated with and conform to the former,—I do not consider it necessary to advert to that discussion further than to observe, that should such unconformity be well established over wide areas, it may ultimately be necessary to introduce a new systematic term, which at present would not seem to be sufficiently warranted, at least in Ireland.

Before passing to the consideration of the Glengarriff grits of the Glengarriff district, I wish to remark, that the fact of the derivative character of these rocks, as noticed by Mr. Du Noyer, who finds them to be composed of the debris of the underlying Silurians, containing fossiliferous pebbles in some localities), is not conclusive, in my mind, of their being an independent formation, whether to be called Devonian or something systematically new,—as I think that cases of derivative rocks sometimes occur in the same continuous series, and that such cases are rather to be expected, if we suppose the existence at points not far distant, of the contemporaneous operation of agencies of denudation and deposition.

I should have mentioned that the fossiliferous Silurian strata of the Dingle district consist of alternations of brown, gray, and green beds, containing upper Silurian fossils, purple slates, reddish and yellowish shales and sandstones, with brown sandstones, and occasional brecciated conglomerates, which latter are also found associated with the upper Glengarriff group of strata, which I now propose to consider. If we suppose that we have overcome the chief, or all the difficulties, that we have had to encounter in endeavouring to interpret the geology of the Dingle district, we will find that upon entering the territories of the Glengarriff grits of the Glengarriff district, we have, as it were, accomplished nothing towards a harmonious view of the rocks composing the south-west of Ireland.

Here at the very threshold we are apparently met with an insur-

mountable difficulty, and that is, that we actually find the Glengarriff grits graduating conformably upwards, not only into the Old Red Sandstone, all the convolutions of which they follow (this latter being identical with the Old Red of Dingle, as well as with that of Waterford, Cork, and Kilkenny); but also, as a matter of course, conforming to the plant beds of the Yellow Sandstone, such as those of the Coomhola or the Roughty Rivers, as well as to the Carboniferous Slate, the Lower and Upper Limestone and the Coal. So that, south of Dingle Bay, we have the Glengarriff grits conforming to the Old Red Sandstone and the Carboniferous series; while north of the bay we have them conforming to the Silurian rocks, and at the same time underlying the Old Red Sandstone and Carboniferous strata unconformably.

The Old Red Sandstone of the promontory south of Dingle Bay extends east and west from the Lakes of Killarney, north of Mac Gillicuddy's Reeks, by Lough Caragh, and north of Cahirciveen to Doulus Head on the west coast; a small outlier occurring from the west of Carrantuohill, to the east of Cummeennapeasta, which forms the summit of the reeks; and again on the south, it occupies the valley of Kenmare, on both sides of Kenmare Bay, as may be seen from the section which I have prepared across the Dingle district to the valley of Kenmare; and it may be said to surround the Glengarriff grits on every side: these rocks again occurring between the Old Red of the south shore of Kenmare Bay, and that of the north shore of Bantry Bay.

The grits which derive their name from the latter district, where they occur in a typical form in the neighbourhood of Glengarriff, being distinguished on my Geological Map by a special letter and colour, consist of greenish and brownish sandstones and conglomerates, alternating with reddish-brown, purple, green, and reddish-gray slates, identical in character with the Glengarriff grits of the Dingle promontory; and they may be seen conforming in innumerable convolutions (though not presenting so much vertical disturbance as those of Dingle), to the Old Red Sandstone at Mac Gillicuddy's Reeks, also near Lough Caragh; and thence extending to the east of it, through the Gap of Dunlo, towards Mucross Lake and Torc Mountain. Again, on both sides of the valley of Kenmare, and southward by the Priests' Leap, to the Old Red Sandstone north of the Coomhola River, in all which cases, there is an almost insensible gradation of the one rock into the other, with nothing to mark the passage beyond the colour of the two series of rocks, and the predominance of reddish-gray sandstone strata towards the top of the underlying grit series.

In endeavouring to render these inharmonious facts as consistent as possible, and to form some sort of definite idea respecting them, I brought to my aid the speculation, which though perhaps not sufficiently satisfactory, I may still offer for as much as it is worth: namely, that we had in the Glengarriff rocks, south of Dingle Bay, a set of strata still higher in the series than those of Dingle, and that, in consequence, as we passed southward, the sequence of the grit strata became more complete. I must, however, confess that it appears to me, at present, that

our path will remain rugged and thorny, notwithstanding every attempt at solution.

In the commencement of my communication I referred to a certain analogy which might exist between the reddish-brown rocks, which conform to the Silurian of the north of Ireland, and certain rocks of the south, which it will now be seen are the Glengarriff grits; both occupy a position unconformable to the overlying rocks, and conformable to the Silurian beneath (at least as far as Dingle is concerned); and I may remark that this is the case, whether the Silurian rocks are upper or lower. Then again, without attaching undue importance to it, a consideration never to be overlooked is, that their lithological composition is not dissimilar, consisting, as both do, of reddish-brown sandstone, brecciated conglomerates, reddish and occasionally green shales with calcareous beds; though in the northern rocks the brownish-red colour prevails, the greenish strata being less frequent. We have also interstratifications in both of beds having an igneous origin, the volcanic ash of Sir H. De la Beche; and though the analogy fails in regard to the typical Glengarriff grits, inasmuch as the northern rocks cannot be compared with them, in respect to the conformity of the latter with the true Old Red Sandstone (as probably no equivalents of this formation occur in any part of the north of Ireland); yet, notwithstanding this, I should say we have a double case in favour of the probability that the Glengarriff rocks will rather be of Silurian than of Devonian age, and I think that it will at all events be admitted, that however the case may ultimately be decided, yet that I was sufficiently justified in the classification, which I have made on my Map, of the Glengarriff grits of the two more southern promontories, as well as those of the peninsula of Dingle, especially in the absence of fossiliferous evidence, and in the presence of the formidable inconsistency in position which I have endeavoured to explain. Indeed, as I before observed, whatever they may be, it will be impossible to class them with the Devonian series, at least so long as that term remains as a synonym of Old Red Sandstone. I may further be allowed to say, that in the analogy which I have endeavoured to establish between the rocks of the north and those of the south of Ireland, I am not to be understood as punctiliously asserting exact identity in their position, the brownish-red rocks of the south being possibly higher in the series than those of the north, my argument being, that both are of Silurian age (at least, as that term has been hitherto understood), whether to be classed, the one with the upper, and the other with the Lower or Cambro-Silurian.

As a short and striking exemplification of the difficulty presented by these rocks, I might suppose the case of two observers acting independently, who subsequently enter into conference relative to the investigations which each had made. One of the parties, who had examined the district north of Dingle Bay, would, I should say, think he had an irresistible case in favour of the Silurian age of these rocks, while the other, whose observations had been limited to the district south of the bay, would as strongly maintain their Devonian character. Upon a

comparison of notes, each, though agreeing as to their identity, might find them chameleon-like, constantly eluding his grasp; till an umpire, arriving from a recent examination of the northern or Pomeroy strata, might decide in favour of the first, or perhaps, equally undecided with both, might offer a new and independent solution. In the absence of fossiliferous evidence, however, I fear we must quietly await the slow accumulation of demonstrative facts.

I cannot here pass over a fact which seems to me to be of importance in the consideration of the question before us, and that is the interstratification with the Glengarriff grits, in common with the schistose Silurians of the east of Ireland, as well as with those of Wales (even though these latter be of lower or Cambro-Silurian age), of the ash beds of Sir H. De la Beche, and of the felstone of Mr. Jukes. These, I believe, are not only identical in lithological character,* but are also referrible to one, extended, no doubt, but still one period of igneous action, in which opinion I am happy to find that my friend Professor Haughton fully concurs; and if so, will it not follow from the theory of their contemporaneous origin with the aqueous rocks, with which they are interstratified,—even though a lengthened period may have intervened between the formation of the upper and lower igneous beds,—that the Silurian rocks across the country, with which I would connect the Glengarriff grits, are also attributable to one extended epoch of sedimentary action, even though a similar lengthened period may have intervened between the deposition of the upper and lower, or Cambro-strata; their separation from unconformity not having been hitherto ascertained by any observations made in Ireland.

In conclusion, I can only say that the principal object which I have had in view in bringing this communication before the Society was for the purpose of assisting a discussion by which we might arrive at some reasonble and satisfactory conclusion in regard to a question which I consider to be of the utmost importance in the advancement of our science, and in which Irish geologists are especially interested.

Professor Haughton stated that in the course of his investigations, both in England and Ireland, as well as on the Continent, he had had ample opportunities of judging of Mr. Griffith's general views, and he had long coincided with his subdivision of the Carboniferous System, having paid much attention to the plants which had been alluded to, and he was happy to find that most of the statements which he had published had been confirmed by that eminent authority, M. Brongniart. He was glad to find that his friend Mr. Jukes also entertained the same views, and he thought, with Mr. Griffith, that the derivative character of the Glengariff Grits was not a sufficient ground for the separation of those

* See Professor Jukes' note to Mr. Foot's paper "On the Trappean Rocks in the neighbourhood of Killarney," vol. vii., Proceedings of the Geological Society of Dublin, page 172.

rocks from the Silurian series. He also alluded to the remark made by Mr. Griffith relative to the associated igneous strata, and stated that he had found them to be similar in composition with those of the Welsh and eastern Irish schistose rocks, as would be seen from several analyses which he had some time since laid before the Society, especially noticing those occurring at Beenaunmore, discovered by Mr. Foot, of the Geological Survey; and Mr. Haughton thought that a lengthened continuance of peculiar igneous action during given periods of deposition will argue contemporaneous similarity of sedimentary condition. He had examined the Pomeroy district, and he agreed with Mr. Griffith respecting the interstratified igneous beds; also believing from his own observation, that the strata of the summit of Carrantuohill and of the Hag's Glen were of true Devonian age. He considered that the alleged unconformity between the upper and lower Silurians should be found very universally occurring before it would become entitled to occupy a place beyond suspicion; as mere overlappings or exceptional disarrangements were liable to be substituted for true unconformities; and he founded the claim to which Mr. Griffith's generalizations and reasoning were entitled upon their intrinsic merit, as well as originality, and not upon the prestige of his name or authority, as Mr. Griffith had never presumed upon any adventitious advantages which the well-deserved reputation, and high character which he had so long enjoyed, might confer upon him. Mr. Haughton also stated, that the value of lithological character in the identification of strata ought never to be wholly neglected.

Mr. Kelly adverted to the vertical strata of the Curlew Mountains, and remarked upon the occurrence of Silurian fossils in them, considering that they were similar to those of the Pomeroy, Clew Bay, Killary, and Glengariff districts. He stated that he could see nothing in Mr. Griffith's paper with which he could disagree, except that, in his opinion, the Old Red rocks of Carrantuohill were not separable from the underlying series; he, however, should say, that the views which he had just heard read were those which Mr. Griffith had always consistently maintained.

Professor Haughton then exhibited a fine specimen of the head of *Oreodon Culbersoni* from Nebrasca, U. S. A., accompanying the exhibition with general explanatory remarks upon the genus; and, in the course of a discussion which ensued, Dr. Carte, and the Director of the University Museum, made some observations upon the general characters of the genus Sus.

The Society then adjourned its meeting to the second Wednesday in December.

WEDNESDAY EVENING, DECEMBER 9, 1857.

Lord Talbot de Malahide, President, in the Chair.

The Society met in the New Museum Buildings, Trinity College, on the above date.

The proposed alteration in the By-Laws was adopted by the Meeting.

The following gentlemen were then admitted as Members of the Society:—

Robert Reeves, Esq.; Richard Dowse, Esq.; William J. Welland, Esq.; Rev. Joseph Carson, D. D.; Rev. Thomas Stack; Rev. Eugene O'Meara; George Bolton, Esq., Jun.; W. H. Baily, Esq.; John Gordon, Esq.

The following gentlemen were admitted as Associate Members for the Session 1857-8:—

W. B. Brownrigg, Esq.; W. D. Babington, Esq.; M. S. Green, Esq.

Mr. Haughton then read to the meeting his paper on the "Cleavage and Joint Planes of the Old Red Sandstone Conglomerate of the county of Waterford," which was illustrated by several diagrams and maps, showing the construction of the Conglomerate. Plate I. represents the general appearance presented by the vertical joint and cleavage planes in the conglomerate cliffs near Dunmore East; these planes completely mask the bedding of the rock, which is nearly horizontal; and give the cliffs a semi-columnar structure which is very remarkable.

In Plate II. is represented one of the singular effects of this columnar-jointed structure, in the formation of a natural stone cross "made without hands," which, seen from the sea, bears a striking resemblance to some of the ruder forms of ancient stone crosses found in Ireland and other countries. Mr. Haughton mentioned some of the principal results he had obtained from the discussion of 345 observations made by him on the cleavage and joint planes, and gave an outline of what he conceived to be the correct mechanical theory applicable to the discussion of such observations; and concluded by stating that, as it was his intention to lay the results, in detail, before the Royal Society, he should not trespass further on the time of the Geological Society than to lay before them the general results he had already described.

Mr. Du Noyer confirmed, from his own observation of the joint planes in the Conglomerate at Sybil Head, county of Kerry, some of Mr. Haughton's observations; particularly with respect to the complete predominance which the laminated cleavage structure of the Conglomerate acquired over the planes of bedding.

Mr. Kelly said he believed that Waterford Harbour formed a kind of boundary between rocks with cleavage and rocks without it; he meant the upper Palæozoic rocks only. The Carboniferous Slate, what little there is of it at Porter's Gate, is not cleaved—or very little. Their equivalents at Clonea, near Dungarvan, are highly cleaved. It is a problem why should there be such a difference east and west of Waterford Harbour. The red sandstones on both sides of it are at sea level, at Templetown and Dunmore, at Ballyhack and Passage; and yet here is the great north and south line of division. An east and west line might be drawn from Waterford, through Clonmel, to Castlemaine. Very little cleavage in the upper rocks north of this line. Very much, all to the south of it.

The polar influence in producing cleavage must give way. It is

not easy to see, either, how the mechanical theory can be proved, for there is both cleavage of rocks and distortion of fossils. When a pebble of conglomerate was split, the whole rock was hard. When a fossil was distorted, the rock was soft. Were there two periods of this kind; or was distortion of fossils connected with cleavage of rocks at all? In fact, are they parts of the same thing?

Professor Haughton said that he was not unaware of the difficulty suggested by Mr. Kelly; it had occurred to himself at the very outset of his investigations, and he felt disposed to cut the Gordian knot by denying that the Conglomerate was hard when cleaved and jointed. According to his idea, the cleavage took place in the planes of greatest pressure, and this pressure, acting even upon a soft bed of wet, loose gravel, would develop a *latent structure* in this mass, including its quartz pebbles, predisposing them to divide cleanly along the planes of maximum pressure.

ON THE IGNEOUS ROCKS OF ARKLOW HEAD, BY J. BEETE JUKES, M. A., F. R. S.

The headland immediately south of the small town of Arklow, near the borders of Wicklow and Wexford, has long been pointed out by our old and respected friend, Mr. Griffith, and others, as containing a very interesting assemblage of igneous rocks, forming, as it were, an epitome of those generally found in the Cambro-Silurian district of the S. E. of Ireland. In June last Mr. Griffith read a paper to this Society, containing his notes, written ten years before, on a traverse which he had then just made across this district, and explaining his views of its structure. It had been the mutual hope and expectation of Mr. Griffith and myself to have gone over the ground together, in company with Professor Haughton, and thus to have discussed our different views on the spot, and combined our information, in order to have arrived at a definite conclusion.

This meeting has unfortunately been deferred, and I hope only deferred; but, finding myself able to run down for two or three days during the last week of November, I took the opportunity of doing so, and will now lay before you the result of my own observations, together with a series of specimens collected by myself on the spot.

I may at once say that there is little or no difference between Mr. Griffith and myself as regards the facts of the case, nor is there room for much difference. The principal varieties of igneous rock are well characterized and clearly exhibited. Our views seem to differ chiefly in our notions as to the origin of some of the more obscure and indefinite varieties. Mr. Griffith, I believe, looked upon all the igneous rocks as intrusive, and on the varieties above alluded to as metamorphic; while I, in accordance with the views first clearly put forth by the late Sir H. De la Beche, and afterwards abundantly elucidated by the work done by the officers of the Geological Survey, both in Wales and Ireland, — allowing fully the intrusive character of some of the igneous rock,— believe that intrusion to have taken place during the Cambro-Silurian

period, while the rocks were yet undisturbed,—and that other varieties of those rocks were poured out as molten sheets at the surface either in air, or under water, accompanied by those mechanically transported ejectamenta, or debris, which we call "ash;" there being every gradation from those igneous materials into purely aqueous slates and gritstones.

The intrusion of the first-named must unquestionably have been accompanied by a certain amount of metamorphic effect on those rocks with which they came in contact; neither are the contemporaneous traps and ashes always devoid of metamorphic characters, since subsequently intrusive rocks would exercise a more marked effect on these than on purely argillaceous or arenaceous rocks. They may have in many instances partaken both of a local metamorphosis, derived from the contact of intrusive rocks, and also of a more general metamorphic effect, which may have either been the result of a long continuance of the elevated temperature which they would attain to when buried under several thousand feet of other rock, or, perhaps may have been the effect of mechanical pressure, or of chemical actions and reactions, which may or may not have been accompanied by heat.

Viewed from this point, the problem becomes a very complex one, since we have a set of rocks, to begin with, of a very various and complicated character, affording almost every gradation from a molten rock to a mud, of the deposition and formation of which we have to unravel the history, to determine, first, which were contemporaneous, and which intrusive; secondly, of the contemporaneous, to discover which flowed as molten sheets, and which were deposited as "ashes" blown into the air, or as fragments worn by the water from previously consolidated masses; and thirdly, of the intrusive we have also to inquire which were erupted previously to, and which subsequently, to the formation of the contemporaneous ones.

We have then to consider the various conditions in which those igneous rocks, together with their associated aqueous deposits, have been placed since their formation,—to take into account that they have been buried many thousand feet deep in the earth, and subsequently re-elevated and exposed at the surface in consequence of the removal by erosion and degradation of those thousands of feet of other rock which had covered them. We have to inquire whether any of the intrusive igneous rocks were injected during any of those subsequent periods of elevation and depression, and, if so, which they were, and how they differ from the intrusive rocks that originally existed in the locality.

Difficult, however, as the problem thus stated may appear, it seems to me that its very difficulty gives it an interest and a charm which was wanting in the previous views taken both of these and of igneous rocks in general. There is a varied history to be learned, a complicated puzzle to be unravelled, and our curiosity thus becomes awakened and aroused, and every step made in advance in the process of investigation becomes watched with an interest that would not be felt in a mere dry detail of matters of fact.

It is for this reason that I have ventured to-night to endeavour to

lead you over the same ground which my valued friend, Mr. Griffith, formerly tracked for you, well knowing that no one will be more ready than himself to hail with pleasure any true additions to our knowledge of facts or any well-grounded extension of our theoretical opinions.

The craggy eminence known as Arklow Rock is about two miles south of the town of Arklow. Its summit rises to a height of 411 feet above the sea, from which it is a quarter of a mile distant, and forms nearly the southern termination of an elevated rocky tract of ground about a mile in length from north to south, and the same distance from east to west As soon as the ground sinks on the land side to the level of 150 feet above the sea, or thereabouts, the rocks become concealed by the Pleistocene deposits which cover all the lower parts of the adjacent country. Of these, the well-known "Marl" is the most conspicuous portion.

The district is divided into two townlands, "Rock Little" on the west, and "Rock Big" on the east. "Rock Little" has a craggy knoll rising to a height of about 250 or 300 feet, which is composed of black and dark gray slate with some gritstone. In Mr. Wyley's notes Graptolites were said to have been found in this. The strike of these slates is about N. 30 E., while that of the cleavage is E. 30 N., the dip of the latter in one place certainly was westerly at 70°; but that of the slates was not so easily determined, from the smallness of the exposed portion of rock. Everybody of experience in slaty countries knows how little dependence can be placed on observations of bedding made on surfaces of a less depth than twenty or thirty feet. At one point the dip of the beds seemed to be westerly at 70°, at another point the beds appeared to be vertical; the strike, however, was pretty constant and uniform, and showed the above difference of about 30° between that of the beds and that of the cleavage, but as the observations were taken in separate spots they are not of much value. When the cleavage was well marked, the bedding lines were obliterated; where the bedding could be determined by the occurence of grit bands, there appeared to be no cleavage, or, if there were, it coincided with the bedding. These little difficulties are of common occurrence.

In the lower ground to the west of the slate ridge are large quarries opened for the purpose of getting a granitic rock of the kind which I propose to call Elvanite. One band of this, in which there are two quarries opened, appears to be at least twenty yards wide, and to run about N.N.E. in the strike of the beds; but on the west side of it, in the lower part of the quarry, three or four smaller and rather irregular veins, of ten to twenty feet only in width, run in a more easterly and westerly direction about E. 35 N. or W. 35 S., as if they branched out of the larger mass, a point which further excavation was required to determine. The slate near these veins was slightly altered, much shattered, and stained of a dark-brown colour, but this alteration could not be perceived at a greater distance than a few feet from the dyke, and at ten yards from it the slate was quite unaltered. The smaller granite veins were composed of a pale-yellow compact or finely granular rock, some-

times rather friable and earthy, appearing like a somewhat decomposed mixture of granular feldspar and quartz. The larger mass was a distinctly crystalline aggregate of feldspar and quartz, with, in some parts, small crests and little detached flakes of white or green mica. It thus formed a perfect granite occasionally, though its general appearance in the quarry was hardly that of true granite, and it required a close inspection of a fresh surface to assure one's self that it was so. It was much jointed in many directions, but large cuboidal blocks were not unfrequent. When broken open, these were often seen to show signs of weathering internally to a depth even of eight inches or a foot, and even when taken from the heart of the quarry. The central nucleus or core of these blocks was a pale greenish-gray, while that core was surrounded by bands of yellowish and reddish-brown, conforming in outline to the external margin of the block, and getting darker as they approached it. This is a very common character in most of the elvan dykes of Wicklow and Wexford, but is one that is not so often seen, scarcely ever to the same extent, in larger masses of true granite. Is it owing to the presence of iron, or some other ingredient which the veins have derived from the masses of other rock which they traversed?

About thirty yards east of the quarries in this Granite or Elvanite, blocks apparently *in situ* appeared above ground of a totally different rock. This was a highly crystalline greenstone, with tabular crystals of feldspar, sometimes half an inch long, but generally smaller, though still distinct, and of a white or pale-green colour, interlaced with crystalline granules of dark apple-green hornblende, and a black lustrous mineral, which is probably another variety of hornblende. Yellow iron pyrites also occurs in small cubical crystals. It was intensely hard, and the blocks were so massive, and weathered into such rounded forms, that it was impossible to detach any but small chips from them. A few yards east of the line in which these blocks occurred, the greenstone appeared to become of a finer grain as it approached the slate. The slate itself near the greenstone was very hard, and had a flinty appearance, probably due to the influence of heat; but this only extended for a few feet, the mass of the slate being quite unaltered.

After crossing the slate ridge to the east, crystalline greenstone again appeared, occupying all the south-eastern slope of the hill of Rock Little, and there was one narrow belt of ground running across the strike of the slates, in which no fragments of slate were to be seen at the surface; but blocks of greenstone did appear. It is possible, then, that here was a greenstone dyke cutting across the slate, and connecting the greenstone on the east with that on the west. If so, it must be very narrow, not more, certainly, than ten yards, as slate appeared again in mass immediately to the north-east of this band.

This greenstone, which occurs in considerable mass on the south-east of the hill of Rock Little, continues down into the small valley which runs between Rock Little, and Rock Big, and the first rock seen after crossing that valley is also greenstone of a similar character. It is probable, therefore, that the valley has been excavated in the greenstone,

as it certainly is further north, where the little brook at the bottom of it falls over ledges of greenstone.

It might at first sight, perhaps, seem unlikely that so hard and so tough a rock as this greenstone would be excavated rather than the cleaved slates which form the hill on one side of it, or the more brittle felstones, &c., which form the loftier hill on the other side. It is, however, a very common occurrence among these old Cambro-Silurian rocks, both in Ireland and in Wales, and elsewhere, that the greenstones have suffered degradation rather than the slates and felstones. The reason of this is, probably, that although very hard and very tough, they are in the first place more open, from their mineral constitution, to the slow action of the weather than the slates and felstones. The silicates of lime, &c., which they contain become converted into carbonates, as may be seen by their effervescing with acids along their cracks and crevices, and at the inner margin of their decomposed part; and these carbonates are then dissolved, and the disintegration of the rock is the consequence. In the second place, greenstones, like basalts and some other igneous rocks, have a concealed internal spheroidal structure, which weathering develops by removing all the angular corners and prominences, and the weathered blocks are, therefore, more easily set in motion by the action of breakers and currents than the more permanently angular felstones, or the flat and shingly slate rocks. During the passage of the land, then, through the upper surface of the sea, at its various periods of slow elevation and depression, it is natural to suppose that the greenstones may have in many instances been more acted upon by denuding forces than the adjacent slates or felstones.

The greenstone now described runs along the whole western side of Rock Big, stretching up the western flank of Arklow Rock, nearly to the summit. Near its boundary, and in some other places, it is fine-grained, and sometimes almost earthy in appearance, though still hard; but in its more central portion it is very crystalline, showing large glittering faces of the black lustrous mineral before mentioned.

The eastern boundary of this greenstone runs in a nearly straight line, about N. N. E. and S. S. W., parallel to the general strike of the rocks, and it is very well defined, and determinable within five or six yards, at several points within the space of a mile.

Parallel to this boundary a band of a very remarkable rock occurs, about 150 yards in width, and running right over the summit of Arklow Rock from one extremity of the district to the other. This rock would be generally called a feldspar, porphyry, or a porphyritic felstone, and over the greater part of its course it would be improper to give it any other name. It consists of a dark gray, or greenish-gray base, full of small white crystals of feldspar, about one-fourth of an inch long; the base or paste, which is quite smooth and compact, likewise exhibiting here and there brilliant facets of crystals of feldspar of the same colour as itself. The white opaque crystals of feldspar are sometimes rather irregular in form, though they do not exhibit any discoloured marks of weathering, nor much appearance of their angles having been worn or

rounded. Notwithstanding the completely porphyritic appearance of this rock where it was first seen, there was a certain indefinable character about it that reminded me of other rocks both in Wales and Waterford, which had been at first taken for porphyry, but were eventually found to be of mechanical formation, and I therefore searched carefully along the band in order to arrive at a true estimate of its character. When traced down to the cliffs at the north end of the headland, the rock was well exposed, and part of it was there clearly seen to be conglomeritic in structure, containing small rounded pebbles of vesicular trap, and rounded and angular fragments of felstone and slate. In one part these were arranged in distinct layers, exhibiting a well-marked lamination striking N.N.E., parallel to the strike of the country, and evidently the result of stratification, and even the white opaque crystals or crystalline fragments of feldspar were in another part likewise arranged in lines and layers, having the same strike as if they had been, not *innate* crystals produced where they are now found, but crystals brought either by water or air and deposited along with the paste in which they were embedded. Some parts of this rock in the quarries on the beach lost altogether the brecciated and conglomeritic character, consisting of dark gray felstone, quite smooth and compact, with little facets of *innate* crystals scattered here and there. The rock, however, retained a streaky or grained structure, in consequence of the parallel arrangement of small layers of different colours and slightly different texture. This grain often exists in truly molten rocks being caused by the flowing of the mass while in a pasty condition; or it may be the mark of an altered ash.

Immediately over these rocks, or to the east of this band, on the coast, is a distinctly stratified rock, about ten feet thick, an ashy shale with interstratified fine-grained grits, or thin layers of felstone (I could not quite determine which), that dipped to E. S. E. at 50°; above that occurred a band about twenty yards wide, of columnar greenstone, the columns of which lay at right angles to the stratification of the slate below, and had both above and below them a thin band of earthy-looking greenstone, and over that were white felstones and slates, apparently interstratified, but much twisted and contorted, large roundish masses of felstone being partly enveloped by beds of indurated shale. Other masses of greenstone appeared obscurely connected or intertangled with them. These irregular and confused rocks occur on each side of the Arch Rock, an overhanging mass which has now fallen down, and beyond them, along the shore to the southward, we come upon a large mass of pure white felstone.

Tracing the porphyritic band at first alluded to, from the coast over the hill, I found exactly in its strike, on the north slope of Arklow Rock, not far from a cottage occupied by George Prestwich, a mass of very coarse conglomerate, the base of which resembled the porphyry, and had both the opaque feldspar crystals and those which seemed certainly *innate* (or produced in the mass), while the whole rock was crowded with pebbles of many other rocks, principally felstone, from the size of the first

downward. The stratification of this conglomerate appeared to coincide with that of the country generally, the strike being N. N. E., and the bedding at a high angle.

Just behind George Prestwich's the porphyry is quarried, and it was here that I procured the specimens, in one of which you will perceive an embedded pebble of felstone of the size of a nut, notwithstanding the crystalline porphyritic and apparently molten character of the rock.

East of this band there extends another band parallel to it, and about 100 yards in width, right across the hill, composed of felstone varying from a rather dark-gray through a pale green to a nearly pure white, having the compact smooth texture usual with this rock, but exhibiting every here and there small glittering facets of crystals of feldspar.

Over, or to the eastward of this, there appear to be some beds of a kind of ash, either felstone or greenstone, or having both characters intermingled, containing at one place on the coast veins of felstone, which are probably the ends of small contemporaneous flows of that rock.

East of these again at the Hanging Stone, and at all places N. N. E. and S. S. W. of it, is a band of greenstone about 80 or 100 yards wide, and very well exhibited along the cliffs. This greenstone is of a finer grain than that before mentioned, but is a well-characterized greenstone. It is remarkable that both in this and in other rocks of the district there is a much greater proportion of iron pyrites in small detached cubical crystals than is usual in such rocks.

Proceeding along the cliffs south of the Hanging Stone, when about a quarter of a mile south of it, the greenstone gradually becomes earthy and friable, and passes into a flaky sort of greenish or yellowish ash, which shortly becomes distinctly stratified, and passes up into thin beds of fine-grained slate and gritstone, and these are shortly overlaid by a bed of coarse conglomerate, twenty or thirty feet thick, over which is more thick, massive ash, and then a small exposure of dark gray compact felstone terminates the section.

These clearly stratified rocks dip E. S. E. at 70° or 80°. The conglomerate is full of well-rounded pebbles of trap and fragments of slate, some of the traps being compact felstone, others quite vesicular, almost pumiceous in appearance, such as I did not see *in situ* anywhere. It had very much the aspect, except from its highly inclined position, of one of the beds of volcanic breccia and conglomerate one so often sees about recent and active volcanoes; and it occurred to me that in these pebbles of vesicular trap we might have preserved the only fragments of the more superficial parts of the flows of molten matter which were produced at the time of the igneous outburst, the compact felstones being the lower part of those molten streams.

As a general result, then, of this description, we may state that here, as in many other localities of the Cambro-Silurian district of the south-east of Ireland and the opposite coast of Wales, volcanic outbursts and eruptions were taking place in the bed of the sea, in which those muds

and sands were being deposited that we now recognise as fine-grained slates and gritstones. That from these active volcanic vents, flows of molten rock were taking place, some of which, being more purely felspathic, consolidated into felstones; others, having the materials for the formation of hornblende mingled with the felspathic base, produced greenstones. Both kinds were accompanied by mechanically formed ashes and conglomerates, just as the trachytic and doleritic lavas of the present day are accompanied by tuff and peperino, and volcanic breccias. It follows, of necessity, that these contemporaneous sheets of trap had their origin somewhere in intrusive pipes, veins, and larger masses, proceeding from the interior towards the surface; and it is probable that the contemporaneous sheets of greenstone proceeded from masses of intrusive greenstone, and that the felstones proceeded from dykes and veins of crystalline felstone; in other words, from a crystalline aggregate of quartz and feldspar, which is, in fact, that variety of granitic rock which I have called Elvanite, and which, whenever it contains a micaceous mineral as a constituent, becomes true Granite.

We must, therefore, look to granite veins and intrusive masses as the deep-seated portion of that mass which, when poured out at the surface, becomes felstone—a rock which has the same feldspar and quartz in a pasty condition, that in the Elvanite are crystallized out. We may then fairly suspect that many of the numerous elvan dykes and veins, and some of the granite masses must closely agreeing with Elvanite, were in fact the deep-seated roots, as it were, from which the felstones have proceeded. Although, then, these dykes and

Section through Arklow Rock.

Scale, both vertical and horizontal, 6 inches to 1 mile.

masses of granite are really intrusive into Cambro-Silurian rocks, they yet belong in reality to the Cambro-Silurian period, being older than the beds which lie above the felstones, though, of course, newer than the parts in which they themselves lie. These are conclusions which I drew from my examination of parts of the county of Wicklow and Wexford, three or four years ago, and which every subsequent examination has tended to confirm.

In the present instance I should look upon the slates of Rock Little as the lowest beds of the district, and, therefore, older than the traps of Rock Big; and I believe the larger masses of these trappean rocks to have been formed in the order of their succession from west to east,—the porphyritic ash having been first formed; then the sheets of felstone, and their accompaning ashes, then the very regular band of greenstone of the Hanging Stone, followed by the deposition of several beds of greenstone ash, those by the formation of beds of argillaceous mud, and afterwards by the thick beds of conglomerate, derived probably from a portion of some of the previously consolidated traps that had become exposed to the action of a current. Other beds of ash and other flows of felstone then took place, as indicated by the highest beds of the section. If the metamorphism that has subsequently produced the *innate* crystalline structure in the porphyritic ash be attributable to the greenstone immediately alongside of it, then, probably, the whole mass of the greenstone on the west flank of Rock Big, and all that of Rock Little, is of intrusive origin, and is newer than the felstones, &c., to the east of it. It is nearly certain that the intrusion of the elvan (or granite) dykes on the west side of Rock Little took place subsequently to the production of the greenstone, both because the greenstone nearest to them is more highly crystalline than the rest, as if it had been remelted; and because in one corner of one of the lower quarries of Rock Little I found a small vein of Elvanite cutting through a mass of greenstone, apparently part of the general mass of the neighbourhood. The elvan, then, must be looked on as the newest rock of the district.

It would follow, however, both from the highly crystalline structure of the elvans and greenstones of Rock Little, and from their boundaries being parallel to the general strike of the country, that their intrusion took place while the beds above them were yet horizontal and undisturbed, either by elevation or denudation; and that their present situation is due to their having partaken in the general movement and general erosion that has effected the whole country, and impressed upon it the general strike of its rocks, and the general outline of its surface.

It has been already stated that the metamorphic effect of any of these rocks is very slight, and confined strictly to their immediate neighbourhood, disappearing at a distance of a few feet from them in the aqueous rocks, and at that of a few yards in those igneous rocks which have been altered.

I believe any disturbing effect consequent on the intrusion of these igneous rocks to have been as restricted as their metamorphic action;

that the intruded rocks were injected as horizontal sheets, gently lifting and floating up the rocks above them, bnt not otherwise tilting or disturbing them,—and that the igneous rocks were all there, and all consolidated into their present condition, *before the commencement* of those great movements of elevation and disturbance by which the Cambro-Silurian rocks were tilted and inclined, not only in the south-east of Ireland, but simultaneously over all the British islands, and throughout Scandinavia and the north-western parts of Europe.

Dr. Griffith observed that in a paper recently read to the Society, respecting a visit made by him to Arklow Rock many years ago, he had put forward views somewhat different from, although on the whole reconcilable with, the statement of Mr. Jukes; and expressed his general concurrence in Mr. Jukes's views, although he confessed he felt still disposed to uphold the old-fashioned metamorphic theory.

Professor Haughton asked whether the occurrence of a band of genuine granitic elvans in the centre of the rocks of this district might not render their highly metamorphic condition explicable; whether he considered them to have been originally of simply aqueous, or of trappean ash origin.

Mr. Jukes having replied satisfactorily to the several queries proposed, Dr. Alexander Carte read a paper "On a Jaw and Tooth of Elephas Cliftii, from the Sub-Himalyas."

Dr. Griffith then moved that the marked thanks of the Society be given to the Provost and Board of Trinity College for their kindness in allowing the Society the use of so spacious and convenient a room for their meetings.

Carried by acclamation.

The meeting then adjourned until the second Wednesday in January, 1858.

DUBLIN NATURAL HISTORY SOCIETY.

SESSION 1857–58.

FRIDAY EVENING, NOVEMBER 13, 1857.

Professor W. H. Harvey, M.D., M.R.I.A., F.L.S., President, in the Chair.

The previous Minutes having been confirmed, the Secretary read the following—

REPORT OF COUNCIL.

In submitting the nineteenth Annual Report, your Council has again to congratulate the Society on its past progress, and on the position which

it now holds. During the Session seven new Members were added to the Society, and one former Member rejoined, making a total increase of Ordinary Members of eight. On the other hand, the loss of Members has been four—Halliday Bruce, Esq., by death; and three, Professor Allman, Dr. Farran, and R. J. Usher, Esq., by resignation. One Associate and six Corresponding Members have also been elected through the year, giving a total gain of eleven Members to the Society.

The additions to the Museum have been both numerous and valuable, as will be seen by reference to the list of them in the Journal, and in the Report of the Museum Committee, about to be presented to you this evening. Your Council cannot but regret, however, that this most important department is not as yet in as perfect a condition as could be desired, owing to the heavy yearly charges under which the Society labours; but it is to be hoped, ere the close of the next year, that some at least of the departments at present incomplete and unarranged will be fully displayed for the inspection of the Members. One important group—the Crustacea—heretofore only partially represented, has been during the year arranged, and, owing to the donations of Members, now contains more than three-fourths of the Irish Decapods, including nearly all of the rarer species, and several unique specimens. These are now so displayed as to be easy of access for reference and identification.

Two years since, your Council entered into arrangements by which the papers read before the meetings should be published in a collected form, in order to preserve in full the new facts elicited during each Session, and thus place the Society in a position to exchange its Transactions with home and foreign Societies. The good effect of this arrangement was so apparent, that when, at the commencement of the past Session, through the unavoidable expenses attendant on the occupation of these rooms, a difficulty arose in carrying out the pecuniary portion of the agreement, your Council felt justified in appealing to the Members to form a publication fund, to which appeal many of the Members liberally responded, and your Council is now enabled to present to each Member not in arrear the volume of Transactions before you.

R. P. Williams, Esq., having liberally placed at the disposal of the Council a number of plates of *Sebastes Norvegicus* and *Cottus Grœnlandicus*, drawn on stone by him from specimens exhibited in this Society, they have appended them to the Journal for this year, with a short account of the record of these rare fishes by William Andrews, Esq., your Honorary Secretary, who first detected their occurrence on the coast of Ireland. A long and detailed paper on the British Oniscoidea was read before the British Association at their late Meeting in this city, 250 copies of which the author liberally placed at the disposal of the Council for presentation to the Members, which it accepted and appended as a Supplement to the Journal: the Journal thus contains eleven plates and woodcuts of rare or new Irish animals.

Dr. Kinahan has kindly undertaken to receive the subscriptions of Members who may be anxious to subscribe to the fund for publication,

and is empowered to dispose of copies of the Journal to Members or others requiring additional copies, at the charge of 1*s.* 6*d.* each to Members, or 2*s.* 6*d.* each to non-Members; these funds to be applied to the publication fund for next year.

Two important alterations were made in the Rules during the past Session,—one, passed at the Annual Meeting in November, having for its object the appointment of Vice-Presidents; the other, passed at the May Meeting, for the establishment of a new class of Members, called Associates, who, by the payment of the subscription of five shillings a year, enjoy all the privileges of Members, except the right of voting, thereby enabling every young naturalist who desires it to join the Society at a trifling expense. Your Council also suggested that Corresponding Members, on the payment of five shillings per annum, should be entitled to the Monthly Reports of the Meetings, and to the volumes of Transactions of the year, which also received the assent of the Meeting. These latter alterations were made too late in the Session to allow of your Council reporting on their utility or otherwise, but they feel persuaded that they must result in the more general spread of the work for which this Society was originally instituted, viz., the illustration and elucidation of the Natural History of Ireland.

During the past month your Council have entered into a satisfactory arrangement with the Dublin Chemical Society, who have agreed to hold their Monthly and other Meetings in your Society's rooms; all interference with the working of this Society, however, being guarded against.

One other subject demands notice, viz., the popular Meetings. Of these, one only was held during the past Session. This arose from a difficulty of procuring papers, chiefly dependent on the fact of most of your working Members being engaged in preparing for the reception of the British Association. The Meeting held was well attended, and your Council would recommend a further carrying out of these Meetings in the ensuing Session.

So many years have now elapsed since this Society was founded, that your Council deem it necessary to review in brief the many important additions made to Irish Natural History through papers read before this Society.

In 1838, to meet a deficiency long felt in this country, the Natural History Society of Dublin was founded, "having for its sole object the elucidation of the Natural History of Ireland, which it proposed to effect by forming a standard collection of species, and by holding Evening Meetings, at which original communications relating to the natural history products of the island might be read and freely discussed." That same year the nucleus of your present valuable Museum was formed, and increased so rapidly by donations (the value of a Museum, at that time the only one of its kind in the city in which duly authenticated specimens could be made available for comparison, being fully apparent to all), that your Society was soon compelled to remove their collection to apartments much more extensive than had been at first anticipated.

Whilst in the full career of its usefulness, the famine years caused in this, as in all societies solely supported by private subscription, such a falling off in its income, as compelled the Council in prudence to give up the rooms then held, and for some years the collections were not available for public inspection. The Monthly Meetings still continued to be held regularly, and many new facts were brought forward and valuable donations still poured in, so that when, on the return of prosperity to the country, your Society once more was in a position to exhibit its collection, it was found to be much increased in specimens of the rarer species, many of them then and still unique. Your Council, however, found itself still unable, through paucity of funds, to render the whole of the collections available, and therefore directed its attention, in the first instance, to those portions of the collection which, being of a comparatively perishable nature, required more immediate attention, hoping, as has indeed been the case, year by year to be enabled gradually to develop the other resources of the collection, and thus render it a complete key to the identification of the rarer Irish species.

Another matter also pressing on the Council caused a drain on the funds, arising from the great and steadily increasing value of the papers read before the Meetings, viz., the necessity, in justice to the Society and the authors of communications, of providing some permanent and available form of Transactions, in which the claim to priority of discovery should be preserved, and published in a form suitable for general diffusion, and thus form by degrees Annals of the Natural History of the country. It, therefore, felt it expedient to devote a portion of the funds of the Society to chronicling the discoveries brought forward at the Meetings, and have been enabled, through means of an advantageous agreement with the "Natural History Review and Quarterly Journal of Science," to publish in full authorized Reports of the Proceedings, which not merely enjoy the full advantages of the circulation of that Journal in Great Britain, Ireland, the Continent, and America, but also at the end of each year enables your Council to present each Member with a full record of the progress made—advantages the importance of which must be apparent to all. These latter arrangements, which have now, as you are aware, been in existence for the last three years, entail on the Society, in conjunction with the rent and other necessary expenses of the Meeting-rooms, an expenditure of above seventy pounds, leaving but a very trifling sum to meet any extra expenses which may arise, and incapacitating the Council from expending on your Museum the sums necessary for its further development.

Your Council have, however, every confidence that it has but to call the attention of the Members, and Naturalists in general, to the importance of a still further increase to its means of usefulness, to obtain, by accession of new Members, &c., such support as will enable it to carry out the good work in which the Society has been for the past eighteen years employed, particularly as, there being no paid officers in this Society, the whole of its income is devoted to one object, viz., the illus-

tration of the Natural History of Ireland, and affording every Irish naturalist a medium by means of which Irish discovery can be registered on Irish ground—a field of labour just as necessary now as when this Society was started, as no other Society or Museum in this country is devoted exclusively to the study of Irish Natural History; and the numerous discoveries made through means of this Society prove, if proof were necessary, the full value of such local labour.

That during the several years of its existence, this Society's labours have not been without their fruit, the following brief summary of a few of the notices of species read before your Meetings since your foundation abundantly prove, and the list might be much increased:—

In Zoology.—Vertebrata, forty-two species.

New to Ireland:—Mammals, two:—Vespertilio Naterreri, 1845; Vespertilio mysta-cinus, 1853.

Birds, six:—Merula Whitei, 1842; Sterna leucoptera, 1844; Puffinus obscurus, 1853; Larus minutus, 1840; Tringa rufescens, 1844; Malocorhynchus membranaceus, 1853.

Reptiles, one:—Caretta caouana, 1849.

Fishes, six:—Orthagoriscus mola, 1839; Orthagoriscus oblongus, 1845; Cottus Grœnlandicus, 1850; Sebastes Norvegicus, 1850; Polyprion cernium, 1855; Tetraodon Pennantii, 1852.

Of the Mollusca, twenty-three:—

New to Ireland, eleven:—Geomalacus maculosus, 1842; Amphipeplea glutinosa, 1844; Pholadidea papyracea, 1850; Pholas striata, 1845; Limneus glaber, 1845; Spirula Peronii, 1845; Bulla hydatis, 1845; Teredo Norvagica.

Polyzoa, three new species of Plumatella.

Of Articulata, twenty-one.

New to Ireland:—

Insects:—Discomyza incurva, 1854; Hydrelia Banksiana, 1854.

Crustacea:—Portunus marmoreus, 1845; Thia polita, 1845; Portunus carcinoides, 1856; Pagurus Eblanensis, 1857; Galathea Andrewsii, 1857; Crangon Allmanni, 1857; Crangon trispinosus, 1857; Hippolyte pusiola, 1857; Hippolyte Mitchellii, 1857; Alpheus ruber, 1857; Iphimedia Eblanæ, 1857; Apseudes talpa, 1857.

Vermes:—Eunice tubicola, 1855.

Of Radiata, &c., seven; all new to Ireland.

In Botany.—Erica ciliaris, Potentilla floribunda, Arabis Crantziana, Lonicera xylosteum, Saxifraga Andrewsii, Spiræa filipendula, Simethis albus, Allium Babingtonii, Equisetum elongatum, Lophodium spinosum, Morchella esculenta, Polyporus betululinus, Nitella hyalina, Chara delicatula, Riccia natans, Riccia fluitans, Berkeleyana fragilis, Chordaria divaricata, Enteromorpha Hopkirkii, Tetraspora cylindrica, Staurocarpus cærulescens, &c. So that the positive number of additional species given to the world through this medium far exceeds 100.

These results cannot but be looked on as bearing your Council out in stating that the Natural History Society of Dublin has indeed

fulfilled the expectations of its founders, and it confidently appeals to the volume now placed in the Members' hands as a proof that there has been no falling off in interest during the past year.

The Council, therefore, feels justified in making a strong appeal to the lovers of the science in this country, to come forward and grant such increased support as will enable the Society to carry out still further the object for which it was formed, by placing it in a position to illustrate papers recording new or rare species, and also to reprint such of the papers read in former years as deserve a more permanent and accessible record than the pages of a daily newspaper, especially as, by a law passed last session, every class of Members can obtain the yearly Annals of the Society.

The Museum of your Society at present contains, of Vertebrate Mammals, 18 species, 20 specimens (only partially displayed), two unique. Birds, 128 species (245 specimens), many of them rare, and several unique as Irish (nearly all exhibited). Reptiles, two species, one unique. Batrachia, 3 species (six specimens). Fishes, only about 20 species (40 specimens), 7 of these, however, of extreme rarity. The difficulty of preserving this group except as spirit preparations acts as a bar to a full representation of the group. A large and varied collection of birds' eggs is in the course of arrangement in this division.

Of Mollusca, a large collection is in possession of the Society, but not as yet arranged. A nucleus of a collection of Insects has been formed during the past year.

In Crustacea the Society possesses nearly a perfect collection of Decapods: 58 species (109 specimens), which have been arranged during the past year, and there are many specimens of the other groups in course of arrangement.

The Radiata are represented by 24 species of star-fishes (42 specimens), partially arranged.

Zoophytes, a large collection, but unfortunately in a bad condition, and as yet not fully arranged.

The Mineralogical collection includes some fine specimens of rare minerals, which have been during the past year fully displayed in the cases, and named according to the latest views.

It will be thus seen that those parts of the collection which are still deficient include chiefly objects which, requiring to be preserved as wet preparations, entail a necessary yearly outlay, which your Council does not at present deem advisable the Society should undertake. The rarer species will be almost all found in the collection, and when the funds permit a larger outlay of money, the Museum can be easily made almost perfect.

On the motion of the Chairman, the Report was unanimously adopted.

The Treasurer next submitted his Report, which showed that the total receipts to the credit of the account current was £64 10*s.* 7*d.*,

against which the expenditure has been £70 2*s.* 11*d.*, leaving a balance of £5 11*s.* 4*d.* due to the Treasurer. He also reported that there were £79 to the credit of the reserve fund, which was an increase of £21 since the previous session, and that subscriptions to the amount of £28 were due by members.

This Report having been adopted, the ballot for officers next closed, and the Chairman declared the following duly elected for the Session 1857–58:—

President.—William H. Harvey, M. D., F. L. S., M. R. I. A.

Vice-Presidents.—His Grace the Archbishop of Dublin, Lord Talbot de Malahide, M. R. I. A., Sir Edward R. Borough, Bart., M. R. I. A., C. P. Croker, M. D., M. R. I. A.

Council.—John Aldridge, M. D., M. R. I. A., Henry M. Barton, F. W. Brady, Robert Callwell, M. R. I. A., James R. Dombrain, A. H. Haliday, M. R. I. A., F. L. S., Samuel Gordon, M. D., M. R. I. A., Rev. S. Haughton, F. T. C. D., M. R. I. A., Robert J. Montgomery, George B. Owens, M. D., Gilbert Sanders, M. R. I. A., Joseph Todhunter, E. Percival Wright, M. R. I. A.

Treasurer.—Richard P. Williams, M. R. I. A.

Secretaries.—Wm. Andrews, M. R. I. A., John R. Kinahan, M. B., M. R. I. A.

The Meeting having been made special for election of Members, after due ballot Willian Archer, Esq., 50, Upper Sackville-street, was declared duly elected as an Ordinary Member of the Society.

The Meeting then adjourned to the 4th of December.

The following Paper by the Rev. Professor Haughton was omitted from the Proceedings of February 13, 1857:—

ON THE GENUS EUOMPHALUS, AND ITS RELATIONS TO PLEUROTOMARIA AND THE HALIOTIDÆ. WITH TWO PLATES.

The Palæozoic genus Euomphalus is one that has given much trouble to palæontologists, in consequence of their hesitation to give the same names to genera of the secondary and Palæozoic periods, and also in consequence of serious variations in the different fossils that have been called by this name. Thus, it would be very difficult to state in what essential particulars the Euomphalus of Sowerby differs from the Straparolus of Montfort, and both from the common Solarium of Lamarck. M. D'Orbigny characterizes Solarium by its quadrangular or rounded mouth, the umbilic mostly crenulated on the rim; and Straparolus by its round or square spines, not crenulated on the rim of the umbilic. M. Pictet justly observes that this crenulation of the rim of the umbilic is not a constant character in Solarium, being, in fact, almost peculiar to the Tertiary species; while in the Cretaceous epoch there are only two or three species with the rim of the umbilic crenulated. I may add to this, that the well-known *Euomphalus pugilis* has the crenulation of

the umbilical margin as fully developed as any fossil or recent Solarium.

Mr. Phillips founds the genus Euomphalus on the character that in the old shells the upper portion of the shell is partitioned off by the animal, which was provided with the means of depositing a septum of shell occasionally, after the manner of the chambered Cephalopoda. There was no communication, however, kept up between the chambers and the body of the animal, as in the Cephalopoda. This character, however, is far from being well established as a general characteristic of the Euomphalus, having been only established in some of the species, as *E. pentangulatus*, *E. acutus*, and *E. pugilis*. M. de Koninck maintains that all the species of Euomphalus have the external lip slit, like Pleurotomaria,—a circumstance which, if true, would undoubtedly require us to remove them from the family of the Trochidæ into that of the Haliotidæ. The character noticed by M. De Koninck is found in some of our Irish Carboniferous species, and is beautifully exhibited in a specimen, *E. reginæ* (Haughton) found by me at Sheffield, Queen's County. This specimen would be referred at once to *E. acutus*, were it not for the accidental preservation of a portion of the shell and of its original colouring and markings, which show that it had a deep slit in the exterior lip, and a sinus band, not distinguishable from that of many species of Pleurotomaria.

While the Euomphalus thus approaches Pleurotomaria in some of its forms, it connects itself with Haliotis in the remarkable species generally assigned at present to Cirrus (not Sowerby). There are three species of this kind known in the Palæozoic period:—*C. cristatus* of Ireland, *C. Goldfussi* of the Eifel, and *C. armatus* of Belgium. These fossils have the form of Euomphalus, and are provided with a series of apertures on the upper surface of the spines, prolonged into tubes, similar in some instances to those of the Haliotidæ, and of these tubes the anterior remain open, while the posterior tubes are gradually closed up. We thus see that while Euomphalus, in its ordinary forms, belongs to the group of low-spined Trochidæ, yet that it keeps up the most intimate relations with Pleurotomaria and Haliotis; so far as mere form is concerned, Euomphalus cannot be separated from Cirrus; and yet the structure and habits of the animals inhabiting the two kinds of shells must have been very different, as the breathing apparatus indicated by the short tubes of Cirrus was of a totally different character, from that of Euomphalus.

If we were to judge by mere form, there would be the greatest difficulty in separating Cyprina from Venus; and yet even a palæontologist could tell that they differed, by the impression of the mantle on the shell.

But, although I admit that slight differences, where they indicate physiological structure, are and ought to be of importance, I may be allowed to doubt if they are as important to the geologist as to the zoologist. It must not be forgotten that, although Geology throws much light on some branches of Natural History, in filling up lacunæ in our

knowledge, yet that our knowledge of the habits and structure of any fossil, however perfect, is at best extremely small, compared with our acquaintance with living forms. It is not, therefore, necessary to be so precise in our subdivisions of fossil as of recent genera, and no greater injury can be done to the science of Geology than has been, by the useless multiplication of worthless names, founded on distinctions which are necessarily trifling, because our knowledge of the true structure of the fossil is exceedingly imperfect.

In the present case (Euomphalus or Solarium), speaking simply as a geologist, it appears to me that all useful purposes will be served by retaining the same generic name for all the varieties, and dividing the genus into three subdivisions, as follows:—

EUOMPHALUS.

Type A.—Flat-spired; provided with breathing tubes like the Haliotidæ. Type species:—

1. Euomphalus cristatus.
2. Euomphalus Goldfussi.

Type B.—Raised spire; provided with a deep slit in the exterior lip, and a *sinus* band on the shell. Type species:—

1. Euomphalus Reginæ (Haughton).

Type C.—Ordinary flat spired, smooth forms of Euomphalus. Type species:—

1. Euomphalus pentangulatus.
2. Euomphalus pugilis.

DESCRIPTION OF PLATES III. AND IV.

PLATE III.

Fig. 1. Under side of unique specimen of *Euomphalus cristatus* (Phillips), preserved in the Museum of Trinity College; locality not certain, but believed to be Strokestown, county of Roscommon. The figure shows the tubular character of the crests, which are closed below; their upper surface is not known.

Fig. 2. Natural cast of same, taken from the upper surface of the limestone slab. The original, exclusive of the spines, is eight inches (nearly) in diameter.

PLATE IV.

Fig. 1. A specimen of *Euomphalus acutus* (Sowerby); somewhat distorted by cleavage, probably from Little Island, county of Cork: this specimen belongs to the Museum of the Royal Dublin Society. It is remarkable for the semicircular sinuosity observable on the lines of growth in passing the keel of each whorl, which must have corresponded with a notch in the outer lip. There is, however, no *sinus*, as observable on Fig. 2.

Fig. 2. *Euomphalus Reginæ* (mihi), found in the lower limestone at Sheffield, Queen's County. Specimen unique, in Museum of Trinity College.

E. Reginæ.—Testâ conicâ; spiræ angulo 70°; anfractibus 6–8, transversim eleganter striatis, sinu lato carinatis, suprà tabulatis; aperturâ subquadratâ scissurâ, altâ superne denotatâ.

Breadth to Height = 150 : 100.

This shell resembles in its general character *E. acutus*, but differs from it in two particulars; *first*, in having a better marked keel, which is formed by the flat upper surface of the whorl making a well-marked angle of 105° with the side; *secondly*, by the Pleurotomaria-like sinus band, which bevils off the angle of the keel; this sinus is $1\frac{1}{2}$ lines broad. The striæ on the surface of the shell form a reversed angle, well marked, as is shown in the figure.

Figs. 3 & 4. Under and upper surface of two specimens of *Euomphalus pugilis* (Sowerby), showing the ornamental knobs, 20 to the whorl, characteristic of this species, which seems to be identical with *Euomphalus turberculatus* (De Koninck). This fossil is rare, although locally abundant in some parts of the lower limestone of the county of Kildare.

FRIDAY EVENING, DECEMBER 4, 1857.

Robert Callwell, Esq., M. R. I. A., in the Chair.

The Minutes of the preceding meeting having been read and confirmed,—

Mr. Richard P. Williams, on behalf of G. A. Pollock, Esq., of Oatlands, announced the donation to the Society of a nearly perfect skeleton of the gigantic Elk (*Megaceros Hibernicus*), found at Dunshaughlin, county of Meath; presented by Richard Barnewall, Esq.

It was proposed by Mr. R. P. Williams, seconded by the Rev. Eugene O'Meàra, and carried by acclamation—

"That in consideration of this very valuable donation, R. Barnewall, Esq., be constituted a Life Member of the Society."

Professor J. Reay Greene, Queen's College, Cork, read—

OBSERVATIONS ON THE DISTRIBUTION OF ACTINOIDA, WITH A LIST OF IRISH SPECIES RECORDED.

These remarks on the distribution of the Actinoida (Helianthoida) are made with a view of drawing the attention of the members to the great numerical discrepancy which at present exists between the *Irish* and *British* lists of these Zoophytes. Upwards of sixty species have already been found on the shores of Great Britain; whereas, the number which has hitherto been obtained on the Irish coast amounts to no more than twenty-two. Several of the more remarkable "non-adherent"

genera, such as Peachia, Edwardsia, Arachnitis, are totally unrepresented in Ireland, though the geographical position of that country cannot be considered as in any way the cause of this deficiency, which seems due rather to the want of attention of Irish naturalists to this branch of Zoology than to any real scarcity of the animals in question. A correct list of the Irish Actinoida is very desirable, those hitherto published having been either incomplete, inaccurate, or both.

In vol. iv. of the late W. Thompson's "Natural History of Ireland," the number of species given is only eighteen, and the notes of the different localities in which these have been observed are rather scanty, and by no means indicative of the relative distribution of the various species around the coast. We must remember, however, that the well-known accuracy of Mr. Thompson forbade him to publish the name of any locality of the existence of which any doubt could be entertained. It should be mentioned, that the name *Actinia gemmacea* in Mr. Thompson's list is meant to designate, not the Zoophyte now so called (*Bunodes gemmacea* of Mr. Gosse), but rather the common *Bunodes crassicornis*, of which it is a well-known synonym. Nine species of Actinoida are found on the Dublin coast, the neighbourhood of Howth furnishing the greater number of them. *Sagartia viduata* has been taken more than once in this locality, and the individuals of *S. dianthus* here obtained exceed, both in size and delicacy of tint, the finest English specimens. It is on the western shores of our island that we are to expect the greater number of discoveries. Most of Mr. Gosse's novelties have been taken on the south-western coast of England, and it is highly probable that an equally diligent series of investigations, carried on round the corresponding districts of Ireland, will be attended with equally successful results.

Sagartia venusta, *S. parasitica*, and *S. rosea*, the first of these being one of the rarest and most beautiful of the Devonshire species, have been obtained by Mr. E. Percival Wright, in the autumn of the present year (1857), on the shores of Bantry Bay, during a very limited search which he made on this part of the coast; and we may readily assume that very many new forms yet await our investigations in this and similar localities. It should be borne in mind that ten years ago the number of British species amounted to but one-half only of what it does at present; and it is not too much to expect that the result of a few years' careful investigation on our more prolific western shores will lead to the discovery of many rare and unexpected species. The subjoined list may be of some use as a basis for future observations.

Irish Actinoida.

Anthea cereus, common round the coast.
Adamsia palliata, Belfast, Waterford.
Corynactis viridis, Crookhaven, Co. Cork.
,, *Allmanni*, Belfast Bay.
Sagartia viduata (*anguicoma*), Clare, Dublin, and Down coasts.

Sagartia troglodytes, Portrush.
,, *rosea*, Bantry Bay (E. P. W).
,, *venusta*, Bantry Bay (E. P. W.)
,, *parasitica*, Bantry Bay (E. P. W.)
,, *bellis*, East coast.
,, *dianthus*, all round the coast.
Bunodes crassicornis, all round the coast.
Actinia mesembryanthemum, all round the coast.
,, *margaritifera*, Belfast, Donegal.
,, *coccinea*, West coast (Dublin Bay ?)
Ilyanthus Scoticus, Balbriggan.
Lucernaria fascicularis, Donaghadee.
,, *auricula*, Carnlough, Co. Antrim.
,, *campanulata*, West coast, Portrush, Bray (?).
Zoanthus Couchii, Strangford Lough.
Turbinalia milletiana, Galway Bay.
Cyathina Smithii, Cork, Waterford, Dublin.

Mr. J. Reay Greene at the same time exhibited living specimens of most of the Dublin species.

Professor J. R. Kinahan next exhibited specimens illustrative of—

REMARKS ON THE ZOE OF EURYNOME ASPERA, AND THE HABITS OF THE ANIMAL IN CONFINEMENT.

The passage of the majority of the higher Crustacea through the zoe state is now a recognised fact in Zoology, and fresh species are turning up almost daily as zoes. That which is exhibited to-night is an example of this, as the zoe of any of the Lambridæ, as far as I know, has never been described.

The specimens from whence the ova were obtained were captured during one of the minor excursions of the British Association, in a dredging party, formed through the kindness and liberality of that well-known and indefatigable naturalist, Robert M'Andrew, Esq., consisting of Professors Allman, Archer, Redfern, Rev. P. Carpenter, of Warrington, Robert M'Andrew, Esq., and son, Dr. Edwards, Mr. Hyndman, and myself. The scene of our labours was the Kish Bank, where, in addition to many other Crustacea, five specimens of *E. aspera* were obtained, two of them loaded with spawn.

These I placed in a small salt-water tank, changing the water occasionally. They were first placed in the tank on the 1st of September; the ova then being of a bright salmon colour. On the 7th I found that the ova in one of them had become much darker, being a dirty drab colour under the microscope, but little change could be detected in the appearance of their contents. On the 10th the ova were a much darker drab, and the black eyes of the zoes plainly distinguishable to the naked eye. The parent had all this time most assiduously kept up a perpetual

current around and through the ova, seemingly by means of the pedipalps, at the same time keeping the mass in constant vibration by rhythmical up-and-down motions of the abdominal false feet, to which the ova were attached. She also sought the sunny side of the tank more than her wont now is. On the evening of the 12th the zoes could be distinguished coiled up in the ova, fully formed, and the motions for aëration were very vigorously carried on; and on examining the tank on the morning of the 13th I found it completely filled with many thousands of zoes, which kept together in one continuous swarm at the side nearest the light. These gradually increased in size, and also altered in their form, seeming so active and healthy that I was in hopes I might have been able to trace their complete changes; but unfortunately the second specimen of *E. aspera* died on the evening of the 17th, poisoning the tank, so that on the morning of the 20th I found my poor zoes dead, putting a stop to experiments as far as they were concerned.

The parent crab, however, still continues in health and vigour, although the water has not been changed till to-day for the last six weeks, and does not now consist of more than two pints in a circular tank, six inches in diameter, and although two green crabs, *C. mœnas,* during the time died from the poisonous effects of impure water. Its habits are interesting; it is but a sedentary animal; it seeks the light occasionally, generally, however, keeping to the shadiest part of the tank. At night it is most active, running over the sides and bottom of the tank after the lights are extinguished, the noise it makes being considerable as it rattles over the glass. Its mode of feeding is sometimes most amusing. On its back, completely concealing it, is a large mass of sponge, which of course the crab carries about with it everywhere; it, however, causes these strange passengers to pay toll occasionally, as frequently I have seen the *E. aspera* stretching its long anterior limbs backwards over its carapace, and, deliberately tearing off a portion of the sponge, coolly proceed to tuck it in between its jaws; sometimes holding the piece of sponge in one of the chelæ, it daintily tears off small pieces from the mass, which it then quietly devours. I detected it once feasting on a little varying Hippolyte, *H. varians,* which was in the same tank; but generally speaking, its food must consist of the Entomostraca and other minute animals, &c., which abound in the water, and possibly also the Ulva. It is a most sluggish animal, slow and deliberate in its movements, and during the day remains with its back to the light in a lair it has formed under a projecting piece of *Ulva lactuca,* its long and beautifully carved arms kept semiflexed at some distance from each side of its body; and the whole animal perfectly motionless, except an occasional vibration of the foot-jaws, looking like some monster in his den. The species is not uncommon in moderately deep water on the banks around the coast, and I would recommend it as a good species to those who keep tanks, as it is generally tenacious of life, and bears travelling well, living for a long time, even in a small quantity of water.

My tanks, in which I have succeeded in keeping many of the rarer Crustacea, are so convenient, and their arrangement so simple, that I am

tempted to describe them. They consist of a number of what are ordinarily called propagating glasses (the dealers call them pro'-glasses), six inches in diameter, and nine inches high; the only thing placed in them besides the water is the *Ulva lactuca*, selecting a broad piece unattached to stones, as I find that stones harbour dirt; the seaweed must be a large piece, as one of its chief intentions is to afford cover and shelter to the animals from the light. It requires to be occasionally renewed, as the animals feed on it. I seldom introduce Mollusca of any kind, as I find them troublesome by dying at unexpected times, and thus poisoning the tank, and I have never seen any occasion for their services in keeping my tanks either clean or healthy.

In this same tank I have had at various times, under the above conditions, the following rare Crustacea:—

Thia polita for four months.

Perimela denticulata, two months, hatched zoes, and was itself killed and partially devoured by Thia.

Hippolyte Cranchii, one month.

H. pusiola, one month.

Crangon fasciatus, three weeks; all killed by Thia.

The varying prawn (*P. varians*), two months.

Squill prawn (*P. squilla*), two months.

Common shrimp (*C. vulgaris*), three weeks.

Hippolyte varians, three months.

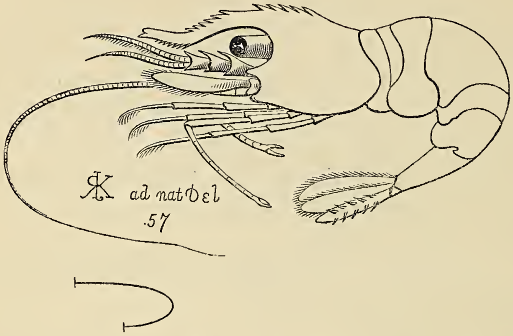
Most of them died merely through neglect in changing the water, which I generally do not oftener than once a month. The tank is kept in a shady place, and uncovered, and the animals are but seldom fed, and then as often on small snails or woodlice as anything else. The sea water for change is kept in a large bottle, with a narrow neck and transparent sides, closely corked, and sometimes, when used, has been three months or upwards in the bottle; so that the keeping of marine animals of the crustacean group is not such a difficult task as is commonly supposed,

The zoes differ from those of *Cancer pagurus* in having no lateral or frontal spines on the carapace; in having no spines at the inner angle of each joint of the abdomen below. The carapace is also very large; the abdomen is divided into six rings; the thoracic limbs are three (?), the most anterior hardly to be distinguished in form from the external foot-jaw of many of the Porcellanidæ.

A discussion arose regarding the practicability of growing Algæ in vivaria without a point of attachment. Professor Kinahan stated that *Ulva lactuca* and *Enteromorpha intestinalis* both do well thus, but that he had found the latter Algæ, even when attached, a bad tank plant, as it is very apt to become yellow. He could not speak of any other species, as he found them to answer so well that there was no necessity for change; the brown weeds he had found were nearly certain destruction to many of the Crustacea.

Dr. J. R. Kinahan read a paper—

ON THE OCCURRENCE OF A NEW IRISH ÆSOP PRAWN (PANDALUS), IN DUBLIN BAY.



But one species of the genus Pandalus of Leach has been hitherto recorded in Ireland. Last July (1857), I met a specimen which appears to be entitled to specific distinction: it occurred to me in a small sandpool in the zostera bank at Sandycove, Kingstown. The shape of the beak is remarkably dissimilar from that organ in *P. annulicornis*, being much shorter in proportion to the length of the animal, rounded instead of compressed at the sides, wanting the membranous dilatation on the under edge outside the eye, and hence, much shallower, and differently armed. It differs from the only other described form, *P. narwhal*, in having the superior anterior half of the rostrum free from spines or teeth. A third species has been recorded, but only a figure of it published by C. Spence Bate, F. L. S., in the "Natural History of Swansea," published in the "Reports of the Swansea Literary Society," under the name of *P. Jeffreysii.* I was at first inclined to consider my specimen this species, but an examination of specimens kindly furnished me by its describer, C. Spence Bates, led me to doubt the correctness of my first belief; that gentleman also appears to doubt it. I deem it better, then, to describe mine, provisionally only, under that name, at the same time suggesting the name *P. Leptorhynchus*, should mine prove distinct.

P. Jeffreysii (Spence Bate), according to a communication of his to me, is tolerably common in Scotland. The original specimens were taken in Oxwich Bay, Swansea; they were two in number, but imperfect at the time figured. They were described at the British Association Meeting at Edinburgh, but only the name published. Mr. Spence Bate has also taken it at Plymouth, and has received it from the Rev. Mr. Gordon, of Moray Frith, as a new species. Some of the specimens from thence have only seven teeth above and two below, instead of eight above and two beneath, which is the usual number.

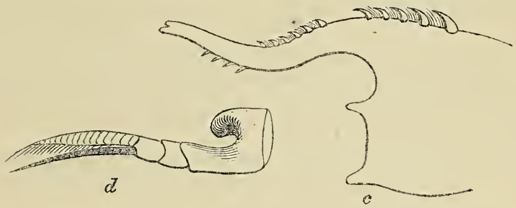
The specimen now described approaches closely *Hippolyte pandaliformis*, and affords another proof of the close affinity of the genera Pandalus and Hippolyte.

Pandalus Jeffreysii (?) (*Spence Bate.*) P. Leptorhynchus (*mihi*).

P. P. annulicorni, affine rostro tenui subrecto vix carapacem dimidio superante undecim spinulis supra armato; infra quadri denticulato; apice bifido.

Colore: rubro.

Habitat: in zonam laminariam, "Sandycove," prope "Dublin."



c, rostrum, much enlarged; *d*, internal antenna, much enlarged.

Narrow-beaked Æsop Prawn.

Closely allied to *P. annulicornis*. Beak narrow, slightly turned up at end; scarcely exceeding half length of carapace; anterior half destitute of teeth above, except a minute one near apex. Eleven spines articulated to the rostrum above; four distinct teeth beneath; interspaces between spines and teeth, with a few hairs; a well developed tooth at base of orbit, and a small one below; internal antennæ lobed at base.

Colour: clear uniform red.

Habitat: sandpools in Zostera bank, laminarian zone, Dublin Bay.

The spinules on the superior margin of the rostrum are articulated to it, as in *P. annulicornis*. Five of them are large and hooked, and situated on the carapace, the fifth being at the edge of ocular notch; there is then a moderately wide interspace: the remaining six spinules being crowded together, and rapidly diminishing in size. The inferior teeth very minute, and situated near the apex of rostrum; there is no dilatation in the rostrum anterior to the ocular notch below; and a nearly total absence of the setæ which so thickly adorn the interspaces of both teeth and spinules in *P. annulicornis*. In habits, the animal resembled *H. varians*, in company with which it was taken.

The beak in typical specimens of *P. Jeffreysii* is straight.

The Meeting then adjourned to the 8th of January.

ROYAL IRISH ACADEMY.

MONDAY, NOVEMBER 9, 1857.

James Henthorn Todd, D. D., President, in the Chair.

On the recommendation of the Council the following Resolutions were adopted:—

1. To authorize the Treasurer to pay a sum of £41 5*s.* 11*d.*, to liquidate the Balance of the cost of printing the Museum Catalogue and arranging the Museum,—this sum being in addition to the sum of £250 voted on the 16th March last.

2. That all moneys derived from the sale of the Catalogue, after the expenses of Advertising, &c., be devoted to the publication of the second part of that work.

Rev. R. Carmichael read a paper on some Brief Methods in the Integral Calculus.

Sir W. R. Hamilton gave an account of some researches of his own on the Theory of Definite Integrals.

MONDAY, NOVEMBER 30, 1857. (Stated Meeting.)

James Henthorn Todd, D. D., President, in the Chair.

In consequence of the unavoidable absence of the author, the following paper by the Rev. T. R. Robinson, D. D., was read by the President—

ON THE LIFTING POWERS OF ELECTRO-MAGNETS.

This paper constituted the third part of Dr. Robinson's researches on the lifting power of the Electro-magnet. In it he examines the dependence of this power on the length and inductivity of the magnetic circuit which is formed when the poles are connected by a keeper. Whatever lessens the inductivity, lessens the magnetic power. If the circuit be incomplete, or if the middle of the keeper or of the magnet be brass, the power decreases to 0·70 or 0·08, or even to 0·02 of its normal amount. Plates of brass $0^{i}\cdot12$ thick interposed between the keeper and poles produce a similar effect; and even the minute interval which remains when they seem in contact is sufficient to destroy $\frac{1}{14}$ of the entire power.

As iron does not transmit magnetic induction without diminution, the same decrease of power is caused by either increasing the circuit or placing the helices at a greater distance from the poles. In the first case, varying the circuit from 12^{i} to 32^{i} reduces the power to $\frac{1}{2}$, in the second changing the distances from $0^{i}\cdot1$ to 10^{i} brings it to 0·87.

If the helices be on one arm only, the poles are unequally excited, the adjacent one more, the remote less, than would be done by the same amount of excitation equally divided between the two arms.

Tables of these results are given, from which he at first hoped to ascertain the law connecting the power with these variables. The problem appears too complicated to be solved by experiment alone, but he offers them as useful data both for theoretic research and practical application.

Various magnets are compared: in general, the lifting power is greater the shorter the magnet, and the closer the spires are brought to its poles; if it be intended to act at a distance, or to magnetize hard steel, it should be long, and uniformly covered with spires.

Beyond 2ⁱ diameter, or even less, the central part of the magnet seems not to contribute to its power.

The power decreases with a rise of temperature if the magnet be iron, the rate varying with its length and section; if of hard steel, it increases, and much more rapidly.

Both with iron and steel there remains magnetism if the exciting current be withdrawn; in the latter case it is permanent and of large amount, and is not destroyed by reversing the current (unless that be of a certain power), even though it produce a temporary reversal of polarity while passing. The power of steel is with ordinary exciting forces far less than that of iron, but with higher they tend to equality.

If a table of the successive powers of a magnet and the corresponding exciting forces be examined, it is seen that they are not proportional, except approximately at the beginning of the series. The increase of the first for a given increase of the second diminishes constantly, and so as to show that in every instance there is a maximum which no amount of current force or number of spires can pass. The precise relation between the power and exciting force has not yet been determined, but he finds that the following empirical formula represents very well, except for the very lowest powers, the action of the seven magnets with which he worked—

$$L = \frac{A\psi}{B + \psi},$$

in which A is the maximum power; ψ the exciting force measured by the quantity of the current × number of spires; and B a constant which may be called the modulus of the magnet, and seems to possess some remarkable properties. It is the ψ which produces a power $= \frac{1}{2}A$, and below which the permanent magnetism is not reversed completely. Below it, also, what he calls residual excitation, that which remains after the current ceases, and till the keeper is raised, varies; above it, it is constant.

The paper concludes with a summary of its contents and those of the two preceding it.

A perfect copy of Charles Brooking's map of Dublin, published in 1728, with a view of the city, and fronts of the public buildings, was presented by Miss Wilkinson.

A list of donations of books presented was read, and thanks voted to the donors.

MONDAY, DECEMBER 14, 1857.

JAMES HENTHORN TODD, D. D., President, in the Chair.

The Rev. Robert Carmichael read a Paper on the Singular Solutions of Partial Differential Equations.

William Kelly, M. D., R. N., read the following Paper on—

THE ANNUAL VARIATIONS OF ATMOSPHERIC PRESSURE IN THE GULF OF ST. LAWRENCE.

The Table which accompanies this Paper is an abstract from the "Meteorological Journal of the Naval Surveying Party" on the St. Lawrence. The observations from which it is taken extend over nine years, from 1841 to 1850. They were made on board the Gulnare surveying vessel, from the end of May in each year, to the middle of October; and during the remainder of the year at Charlotte Town, Prince Edward Island, where the party wintered.

Two ordinary marine barometers were employed in making these observations. The first got out of order in June, 1845, and the second was not obtained until the September following. The indications of the latter were somewhat lower than those of the first, which agreed generally with other barometers of the same construction. There was no apparent difference, however, in the range of the instruments, which, it is scarcely necessary to say, was less than the true range; not only on account of the varying level of the mercury in the bag, according as it ascends or descends in the tube; but also from hygrometric causes acting on the bag itself; the instruments having been kept in the moist air of a vessel at sea during the summer, and in the dry air of a house warmed by stoves during the winter.

From the mean of all the observations we find that the atmospheric pressure is least in January, February, and March; that it increases slowly in April and May, and that there is a very slight decrease (·01) in June; that the pressure is greatest in July, August, and September, after which it decreases gradually through the three remaining months of the year.

The annual course of atmospheric pressure which we find here, on the north-east coast of America, derives interest from the fact that a similar course has been as yet observed only at Sitka, on the extreme north-west of the continent, and in Europe at considerable mountain elevations. Nothing apparently connected with it, either by similarity or contrast, has been observed on the mainland of North America; but in the sea to the north of the continent, which in following the coast-line may be said to lie between Norfolk Sound and the Gulf of St. Lawrence, we find an annual course of atmospheric pressure, decidedly different from that which obtains in these seas.

Summary of Barometric Observations made in Charlotte Town, and the southern parts of the Gulf of St. Lawrence, between 1841 *and* 1850.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1841						29·964	29·958	30·115	30·044	29·837	29·729	29·816
1842	29·789	29·838	29·899	29·895	29·842	29·986	30·044	30·172	29·943	29·899	29·852	29·853
1843	29·946	29·725	29·663	29·927	29·977	29·900	29·960	30·120	30·020	29·843	29·857	29·920
1844	29·657	29·928	29·923	30·070	29·927	29·970	29·933	30·036	30·063	29·985	29·800	29·777
1845	29·894	29·856	29·895	29·900	29·944	. . .	. . .	. . .	29·790	29·983	29 695	29·712
1846	29·568	29·590	29·716	29·776	29·736	29·808	29·750	29·817	29·803	29·873	29·704	29·510
1847	29·610	29·623	29·520	29·593	29·790	29·847	29·903	29·959	20·883	29·821	29·764	29·774
1848	29.820	29·485	29·682	29·782	29·704	29·773	29·909	29·910	29·802	29·783	29·765	29·784
1849	29·617	29·887	29·813	29·583	29·817	29·769	29·872	29·892	22·975	29·820	29·690	29·590
1850	29·730	29·560	29·470	29·590	29·720	29·748	29·797	29·724	29·791			
Means	29·737	29·722	29·725	29·791	29·829	29·863	29·903	29·972	29·901	29·872	29·762	29·748

Mean of all the Observations reduced to the Level of the Sea.

Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
29·781	29·766	29·769	29·835	29·873	29·863	29·903	29·972	29·901	29·894	29·806	29·792

From the observations carried on for three years, on board H. M. S. Investigator, in Melville Sound, and those of Captain Parry, at Melville Island, we find that the barometer was always lowest in July, August, and September; and comparatively high, although not highest, in January, February, and March. The low state of the barometer in the former months was marked in all Parry's voyages; but from his observations, as well as from those made in the Investigator, the greatest height was in April and May.

It would seem that the annual course of atmospheric pressure, which prevails all over Asia (and which is the reverse of that observed in the Gulf of S. Lawrence), extends beyond the shores of Siberia, and is met in a modified form, on the American side of the Arctic Sea.

The President read a letter addressed to him by the Baron de Bonstettin, containing inquiries respecting ancient pipes discovered in excavations in Ireland.

The following antiquities were presented to the Museum:—

1. An iron spear-head found in the county of Fermanagh. Presented by Miss Richardson.

2. A small cinerary urn, found near Cabinteely, on the land of the donor. It was discovered in the centre of a small chamber filled with a mixture of clay and bone-dust, and covered with a large flag, and about two feet of earth. Presented by J. H. Jessop, Esq.

3. A small glass bottle, found in Ardglass, county of Down. Presented by Rev. J. H. Todd, D. D., President.

4. Five modern Indian coins, and a small ingot of silver. Presented by William Kennedy, Esq.

5. Several copies of the new Index to the Ordnance Map of Ireland, in the scale of one inch to the statute mile, showing the state of publication on the 30th of November, 1857. Presented by Captain Leach.

DUBLIN UNIVERSITY ZOOLOGICAL AND BOTANICAL ASSOCIATION.

FRIDAY EVENING, NOVEMBER 20, 1857.

Rev. Professor Haughton, F. T. C. D., Vice-President, in the Chair.

The Chairman having congratulated the Association upon their past progress, and expressed his sanguine hopes of their future success and permanence, founded upon the fact that this Association secured its members at their entrance into life, and bound them to its service by all the kindly recollections which every true son must bear through life to his Alma Mater,—passed a brief eulogy on their late deeply lamented President, Dr. Ball, and then reviewed rapidly the papers read before the Association during the past season, and published in the fourth volume of the "Natural History Review."

Among the more valuable of the papers mentioned were Dr. Harvey's description and figures of new British Algæ; Mr. Haliday's valuable additions to various branches of entomological science, including descriptions of a new genus and species of Diapridæ, and some valuable hints for observers as to the lacunæ yet remaining unfilled in the ranks of the native Diptera; Mr. Archer's interesting list of Desmidiaceæ from the neighbourhood of Dublin; Mr. Warren's list of the Natatores of Killala; and Mr. Greene's Acalephæ of the Dublin coast. Among the more popular of the papers, Mr. Haughton specially noticed Dr. Harvey's account of the Cannibals of the Feejee Islands, and Professor Smith's Botanical Rambles in the Pyrenees. The mention of this latter paper reminded Mr. Haughton that they, in common with the world of naturalists, had to mourn the death of its talented author, as well as that of their well-known late President, Dr. Ball, both removed within the past year from

the scene of their labours, by a fate which, judged of by human reason only, must be considered premature. He was happy to inform them that a memoir of their late President, written by Mr. R. Patterson, of Belfast, would be shortly placed in their hands. At the close of the preceding session Dr. Harvey had commented upon the loss sustained by them in the death of their late President. On this melancholy subject there could be no difference of opinion; but though their fellow-labourers had passed from their mortal vision, let them not be banished from their kindly recollections, and let the example they had set of zeal in the pursuit of science ever animate their successors and followers. During the meeting of the British Association in Dublin, this Association had been well and efficiently represented in Section D by Mr. E. Percival Wright's highly interesting and valuable description of the blind Lipura of the Mitchelstown Caves; by Mr. Greene, in his description of seven new naked-eyed Acalephæ of the Dublin coast; by the Rev. Eugene O'Meara's paper on the Diatomaceæ occurring in chalk; and, lastly, by Dr. Kinahan's elaborate and most valuable analysis of certain genera of terrestrial Isopoda. The foregoing papers formed a list, in Mr. Haughton's opinion, which would be highly creditable to the members of any society, and afforded good grounds of hope for the future fame of many of their junior members and associates. Among these papers there was only one which touched on Palæontology, a defect for which Mr. Haughton confessed himself somewhat to blame, and which he hoped would be rectified in future years. With regard to their prospects of papers for the coming winter, the Association might reckon with confidence on the entomological stores of Mr. Haliday, the botanical reserves of Dr. Harvey, the accumulated wealth of the College Museum, zoological and geological, in displaying which before them they might reckon on the zeal of the present Director of the Museum and himself. These would, undoubtedly, form the staple of their contributions, not to be called for unless other papers were wanting, but sufficient to fill up all gaps, and render every meeting of the Association interesting and instructive. At the conclusion of his address, Professor Haughton laid before the meeting the arrangements of the Board of Trinity College, by virtue of which Zoology and Botany were raised to the rank of the studies of the University, and incorporated with Physics, Chemistry, and Geology in one Moderatorship, to be called the Moderatorship in Experimental and Natural Science. The Moderatorship in Experimental Science was founded in 1851, and after the experience of seven years had been found to work so well that the authorities of the College had decided on giving the same encouragement to the study of the natural sciences among the students of the University. The following is the course of study prescribed for the year 1858, in the several branches of Physics, Chemistry, Geology, Zoology, and Botany:—

MODERATORSHIPS IN EXPERIMENTAL AND NATURAL SCIENCES.

The following has been appointed for the Examination as a permanent Course of study; in addition to which special practical studies will

be indicated from year to year. Half of the total marks in each subject will be devoted to the special studies:—

1. Physics.—Pouillet, Elements de Physique et de Meteorologie. Lloyd, Elementary Treatise on the Wave-Theory of Light.
2. Chemistry and Mineralogy.—Regnault, Cours de Chimie. Dana, System of Mineralogy. Rose, Elements de Crystallographie (traduit de l'Allemand par M. Victor Regnault).
3. Geology.—Lyell, Manual of Elementary Geology. D'Orbigny, Cours Elementaire de Paléontologie et de Geologie Stratigraphique (Partie Troisième).
4. Zoology.—Dallas, Natural History of the Animal Kingdom. Woodward, Manual of the Mollusca.
5. Botany.—Henfrey, Elementary Course of Botany, Structural, Physiological, and Systematic.

SPECIAL STUDIES FOR 1858.

Physics.—Meteorology, especially that of Ireland, as illustrated by Dr. Lloyd's Report to the Royal Irish Academy.

Organic Chemistry.—The following parts of Miller's Elements of Chemistry, vol. iii.:—Chaps. I., II., III. Chap. IV., sect. i., and sect. ii. from paragraph 1059 to paragraph 1064. Chap. V., sect. i. Chap. VII., sect. i., from paragraph 1203 to paragraph 1216. Chap. IX., from paragraph 1317 to paragraph 1329. Chap. X., sects. i. and ii. Chap. XIV., sects. i., ii., and iii.

Geology.—Theories of Cleavage, Joints, Foliation, and Metamorphism of Rocks. The Palæozoic Crustaceans.

Zoology.—British Testaceous Mollusca; with especial reference to the development and anatomy of the types of the following Genera:—Anomia; Purpura; Chiton; Helix; Terebratula; Akera.

One-fifth of the special marks will be reserved for collections of British Testaceous Mollusca, collected and named by the Candidate during the preceding year.

Botany.—In Systematic Botany the Examination will be confined to the following Orders; which the Candidate will be required to illustrate by reference to the commoner native plants belonging to each:—

Ranunculaceæ, ... Papaveraceæ, ... Cruciferæ, ... Caryophylleæ, ... Geraniaceæ, ... Rosaceæ, ... Compositæ, ... Rubiaceæ, ... Boragineæ, ... Labiatæ, ... Scrophylarineæ, . . . Polygoneæ, ... Euphorbiaceæ, . . .	1. Characteristics of Order. Its structure and properties. 2. British Genera and Species. 3. Specimens will be produced at the Examination, which are to be correctly named and classed by the Candidate. 4. The Candidate will have to give a written description of one or two selected plants, to test his famirity with botanical terms.

Lastly, one-fifth of the special marks will be reserved for collections of native plants, fairly dried, and which have been collected, examined, and correctly named, by the Candidate, during the preceding year. This collection not to be restricted to plants of the above Orders, but to comprise the greatest number of species which the Candidate can obtain. The name of Genus and Species, and of the natural Order to which it belongs, to be affixed to each specimen.

At the conclusion of his address Mr. Haughton reminded the members, many of whom were undergraduates, of the advantages now opened to them by the College lectures on Zoology, Geology, Chemistry, and Physics, and of the high reward now for the first time offered to the study of Zoology and Botany in the University of Dublin. The title of Gold Medallist of the University of Dublin was one which he hoped would always be a high distinction for a young man to attain to; and he felt confident that among the young naturalists he had the pleasure of addressing, there were some who, if honored with such distinction for their zoological and botanical knowledge, would eventually prove themselves as worthy of that title as the best mathematicians and scholars this University had ever produced.

The Secretary read a paper, entitled—

NOTE OF THE OCCURRENCE OF THE HYPEROODON BUTZKOPF (BOTTLE-NOSED WHALE). BY ROBERT PATTERSON, M.R.I.A.

On the 22nd September, 1857, a whale of this species was captured on the southern shore of Belfast Bay, in one of the channels between Belfast and Holywood. I had the opportunity of seeing it on the ensuing day; and afterwards, by the kind co-operation of Mr. Richard Allen, Assistant Engineer to the Harbour Commissioners, ascertained its dimensions.

Mr. Thompson has recorded ("Natural History of Ireland," vol. iv.) the occurrence of this species of whale in the same Bay on two former occasions. The first was taken at Ballyholme, near the entrance to Belfast Bay, on the 16th September, 1839; the second at Cultra, on the 29th October, 1845. That taken on the 22nd September, 1857, was the third in the space of eight years. All three were killed on the county of Down shore of the Bay, and at nearly the same season of the year.

The measurements of the Cultra specimen of 1845 are republished here, that they may be compared with those of the more recent capture. The former was a male; the latter, a female. The dimensions are very similar. The stomachs of both contained the beaks of cuttle-fishes. Four teeth were found in the Cultra specimen, the skull of which is preserved in the Belfast Museum; two only were detected by Professor Dickie in that of the other. The weight of the Hyperoodon of 1857 was $2\frac{1}{2}$ tons; the quantity of oil produced was 90 gallons.

Measurements of the Hyperoodon taken in 1857 *and of that in* 1845.

	1857. Ft.	1857. In.	1845. Ft.	1845. In.
Length, measured in a straight line from snout to tail,	20	5	20	4
Ditto, measured along the dorsal curve,	22	6	23	4
Greatest height,	4	3	4	6
Ditto, girth,	11	0	11	6
Breadth of head, on a line from eye to eye,	2	9	3	0
Length of rostrum,	1	2	0	11
Depth of jaw at point,	0	3½	0	4
Length from point of snout to eye,	3	6	3	1
Blow-hole from point of snout following dorsal curve,	3	2	3	9
Ditto, in length (crescentic form),	0	6	0	6
Pectoral fins, from base of snout,	5	5	5	0
Ditto, space between them,	1	8½	1	7
Ditto, in length, from base at upper side to point,	2	1	2	2
Ditto, in breadth, greatest,	0	8½	0	7
Dorsal fin distant from caudal fin, estimated from a straight line drawn from snout to tail	7	1	8	0
Dorsal fin, length at base,	1	6	1	7
Ditto, length from base to point (points backwards),	1	0	1	0
Caudal fin, greatest length,	1	9	1	11
Ditto, ditto, breadth,	5	10	5	6
Ditto, ditto, thickness,	0	4½	0	3
Aperture anterior to vent in length,	1	5½	1	0
Ditto, ditto, of vent in length,	0	6	0	6

It may be proper to remark, that these measurements should be regarded only as *approximately* correct. Perhaps no two individuals, measuring the same specimen at different times, would exactly agree in their record.

The Secretary also read a paper—

ON THE TEETH OF THE HYPEROODON. BY DR. DICKIE.

On my arrival in town some weeks after the capture of the Hyperoodon, I accompanied Mr. Patterson to the chemical works of Mr. Ritchie, where the bones of the animal were lying. We examined the jaws very carefully, but found only two teeth, one on each side of the lower jaw, near the symphysis. Each is a hollow cone, open and jagged at the base, and ending somewhat abruptly in a very sharp point. I prepared a longitudinal section of one of the teeth, and found a small quantity of osteo-dentine at the base, with a layer of cement inclosing the central dentine. The cement extended all over the tooth, but was very thin at the apex, this thinning taking place abruptly a little way below the tip. Enamel is altogether wanting, in which respect the teeth of Hyperoodon differ from those of the Dolphin, which have a layer of enamel near the end.

Professor Owen, in his "Odontography," alludes to tubercles on the roof of the mouth which are supposed to represent the baleen of the Balænidæ; he had not examined any specimen of these tubercles. Unfortunately, in the example which came under my notice, all the softer

parts had been removed from the upper and lower jaws, except those which correspond to the gum, and embedded in the putrid, though still very tough, remains in which we found the two teeth alluded to.

After which the members proceeded to ballot, and the following gentlemen were elected as officers for 1857-58 :—

President.—Alexander H. Haliday, A. M., M. R. I. A., F. L. S., &c.

Vice-Presidents.—Professor W. H. Harvey, M. D., M. R. I. A., F. L. S., &c., and Rev. Professor S. Haughton, A. M., F. T. C. D., M. R. I. A., &c.

Honorary Members.—The Rev. the Provost, the Rev. the Vice-Provost, the Senior Fellows.

Treasurer.—The Rev. Thaddeus O'Mahony, A. B.

Librarian.—W. B. Brownrigg, Science Scholar, T. C. D.

Honorary Secretaries.—Joseph Reay Greene, Professor of Natural History, Queen's College, Cork; and E. Percival Wright, A.B., M.R.I.A., Director of the University Museum.

Botanical Committee.—W. H. Harvey, M.D., Professor of Botany, V. P., Chairman; William Archer; John Bain, Curator of the College Botanic Gardens; Rev. Eugene O'Meara, A. B. (Council); H. C. Beauchamp, M. B., M. R. I. A.; E. Percival Wright, A. B., Secretary.

Zoological Committee. — Rev. S. Haughton, A. M., Professor of Geology, V. P., Chairman; Alexander Carte, A. M., M. B., &c.; Alfred Furlong, M.R.I.A.; Robert Harrison, M.D., Lecturer on Zoology, &c.; J. R. Kinahan, A.B., M.B., &c. (Council); J. Reay Greene, Secretary.

Council.—The President, the Vice-Presidents, the Treasurer, the Honorary Secretaries, Rev. Eugene O'Meara, Botanical Committee; J. R. Kinahan, Zoological Committee; Professor Harrison, M. D., Professor Ingram, LL. D., Professor Stokes, M. D.

FRIDAY EVENING, DECEMBER 18, 1857.

Professor W. H. Harvey, M. D., F. L. S., Vice-President, in the Chair.

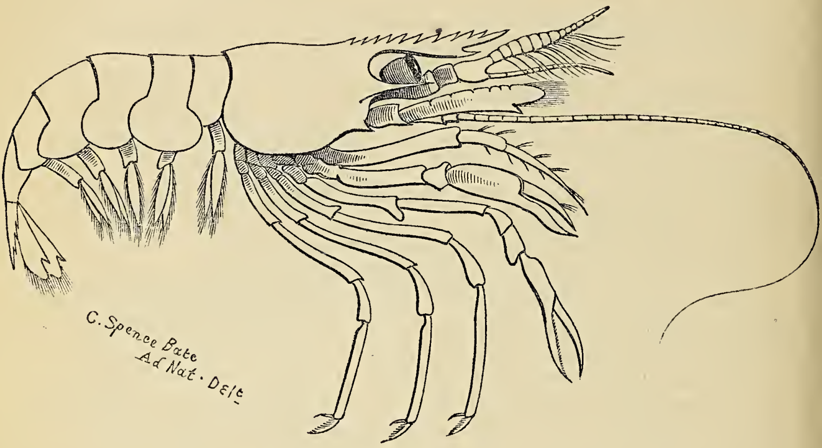
The Minutes of the previous Meeting being read, were approved of, and signed by the Chairman.

Professor Kinahan communicated the following description, by C. Spence Bate, F. L. S., of—

A NEW BRITISH HIPPOLYTE.

Hyppolyte rostro decem dentibus ornato marginem superiorem, et ad marginem inferiorem uno dente. Spinâ longe ad marginem inferiorem

orbitæ. Chelæ ad primum et pedarum secundum paria digitos longos et graciles habent. *Dactyla* ad *pereipoda* et posteriores cum dentibus ornatis.

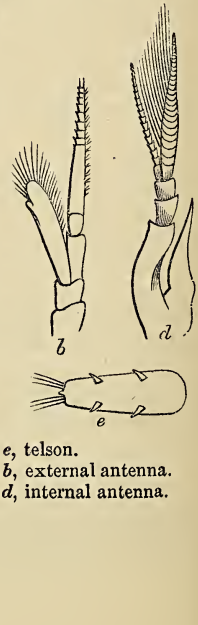


Rostrum armed with ten teeth above, and one below; a long spine at the lower margin of the orbit; first and second pair of hands with fingers long and slender; the last joint of each leg fringed with teeth; and one stout hair curved in a contrary arch, springing from the posterior extremity of the penultimate joint.

This species was sent me by the Rev. G. Gordon, from Moray Frith, among other Macroura, including *P. Jeffreysii*. The basal joint of the internal antennæ is developed on the inner side into a squamiform tooth which reaches beyond the first articulation. External antennæ with the tooth at apex of squamiform scale, remote from upper extremity. Central plate of tail (telson) terminates in a minute and central point. Three stout hairs on each side. Lateral margin with two stout, articulated, short spines.

The long and elegantly formed hands, and large size of second pair of feet, separate it from the other known British species.

I have named it after its discoverer, the Rev. G. Gordon, of Elgin.



e, telson.
b, external antenna.
d, internal antenna.

The thanks of the members were voted to Mr. C. Spence Bate for his paper.

Mr. Edwin Burchell read the following paper—

ON ADDITIONS TO THE IRISH LEPIDOPTERA.

Although I feel that the materials at my command for drawing up a supplement to the Rev. Mr. Greene's valuable list of Irish Lepidoptera are very meagre, yet, as three years have elapsed without any one better qualified than myself undertaking the task, I venture to record a few additional species which have come under my observation. To Mr. Alexander G. More, of Bembridge, I have to express my obligation for a very complete record of his captures during a residence of several months at Ardrahan, which has enabled me to add no less than eleven species to our list:—

Polyommatus ægon, near Galway. June.
Erebia Cassiope, near Westport. July.
Trochilium tipuliforme, Gardens, Dublin.
Lithosia miniata, Galway. A. G. More.
Setina irrorella, Galway; abundant. June.
Liparis auriflua; generally distributed.
Endromis versicolor, Powerscourt.
Clostera curtula, Tullamore and Clonmel.
Fumea nitidella, abundant at Howth. June.
Acronycta aceris, larvæ at Malahide.
Nonagria despecta, Galway. A. G. More.
Zylophasia sublustris, Galway; abundant at Sugar. June.
Miana expolita, Galway, abundant.

Discovered at Darlington in 1855, and not previously recorded as found elsewhere:—

Agrotis aquilina, Killarney, at Sugar.
Agrotis corticea, Galway. A. G. More.
Aplecta nebulosa, Galway. End of June, at Sugar.
Aplecta herbida, Galway. End of June, at Sugar.
Hadena lutulenta, Galway. Mr. More; at Sugar.
Hadena dentina, Galway. Mr. More; at Sugar.
Noctua umbrosa, Galway. Mr. More; at Sugar.
Philopyra pyramidea, Galway. Mr. More, at Sugar.
Teniocampa gracilis, Killarney.
Dasycampa rubiginea, Dublin. January and November.
Aspilates citraria, Powerscourt, among fern.
Aspilates gilvaria, Galway. Mr. More.
Cabera strigillaria, Powerscourt.
Bapta temeraria, Galway. Mr. More.
Macaria literaria, Powerscourt.
Dosithea reversaria, Galway. Mr. More.

Emmelesia ericetaria, Galway and Powerscourt.
Eupithecia expalidaria, Powerscourt.
,, *pygmearia*, Howth.
Asopia flameulis, Galway.
Botys fuscalis, Galway.
,, *pandalis*, Galway.
Hypena crassalis, Carrick-on-Suir. Dr. Carte.
Polypogon tarsicrinalis, Galway. Mr. More.
Nola cucullalis, Powerscourt.

It will be observed that the majority of the species are from Galway. The locality was not selected for investigation from any belief that it was likely to be peculiarly productive; on the contrary, the district between Galway and Gort, in which most of the insects were captured, is very scantily wooded, and presents a most unpromising aspect to the collector. But the fact that out of 102 species of Lepidoptera captured in the county of Galway during the past summer, 19 species (all of them conspicuous insects) are new to the Irish list, is conclusive evidence of its present very imperfect condition. In my opinion the island is, to a great extent, a *terra incognita*, and our list of Lepidoptera quite as long as it deserves to be for the amount of labour bestowed on the subject.

Our list of butterflies is remarkable, both from containing species which might have been expected to fail in Ireland—such as *Cratægi*, *Betulæ*, and the two *Colias*,—but still more so from the absence of about six others—*Adippe*, *Polychloros*, *Calbum*, *Selene*, *Euphrosyne*, and *Alveolus*—which might have been confidently expected to occur from their almost universal diffusion in England, and to the powerful flight of at least three of which the channel would scarcely be a barrier.

I suspect all six only want looking for. It will be time enough to lament the poverty of our Fauna when every nook and corner of the island is ransacked, by day and by night, as is the case in England, with the most surprising results, year after year.

I wish to draw attention especially to the south-western district, which is almost entirely unexplored by the lepidopterist. Who will go up and possess it?

When the late Professor Edward Forbes suggested the grand idea of the former connexion of Ireland and Spain by means of an ancient continent stretching far out into the Atlantic, his theory was based mainly on botanical grounds; for, after stating that the west and south-west of Ireland is characterized by botanical peculiarities, dependent on the presence of about twelve prolific species of plants, and that the nearest point of Europe where these plants are native is the north of Spain, he adds, "there is no evidence of any local assemblage of animals corresponding to this Flora."

The recent discovery of *Anthrocera Minos* in the district, and apparently confined to it, proves that there are also traces of a peculiar Fauna, and leads me to anticipate that a diligent collector in the south-west would reap a rich harvest of novelties among the Lepidoptera.

When in Galway this summer, Minos was, as usual, in great profusion. It differs materially in its habits from the other native species of the genus, concealing its oval, earth-coloured cocoon (of which I have the pleasure of exhibiting specimens) among the roots of the herbage, or attached to a stone at the surface of the ground; but from the nature of the localities in which alone the insect is found in abundance,—viz., fields in which rock was the rule, grass the exception,—the cocoon is extremely difficult to find.

Professor J. Reay Greene, Honorary Secretary, read a paper entitled "Notes on the present state of our knowledge of the Cœlenterata."

Rev. Joseph Greene, M. A., exhibited specimens of the very rare *Deilephila galii*, in the most beautiful state of preservation, taken near Deal; also a hybrid moth, bred from *Smerinthus populi* and *S. ocellatus*.

Mr. E. Burchell exhibited a box of specimens illustrative of his paper.

The Rev. Professor Haughton, V. P., exhibited an unique specimen of *Euomphalus cristatus* (Phillips), preserved in the Museum of Trinity College.

The Meeting then adjourned to January 15, 1858.

GEOLOGICAL SOCIETY OF DUBLIN.

WEDNESDAY EVENING, JANUARY 13, 1858.

Robert Mallet, Esq., in the Chair.

The following gentlemen were elected Members of the Society:—1, Joseph Kincaid, Esq., 3, Herbert-street; 2, Thomas Hampton, Esq., C.E., 108, Lower Baggot-street; 3, George A. Craig, Esq., C. E., 108, Lower Baggot-street; 4, James Glennan, Esq., Dolphin's Barn (as Associate).

The notice of motion from Council was read, viz.:—"Any person residing as above, who shall have paid an admission fee of £5, shall be at liberty, at any time, to compound for his annual subscription by a payment of a further sum of £5."

Mr. J. Beete Jukes read the following paper:—

JUNCTION OF THE LIMESTONE, SANDSTONE, AND GRANITE AT OUGHTERARD, COUNTY GALWAY. BY JOHN BIRMINGHAM, ESQ.

In few places in Ireland can the junction of the granite with other rocks be seen to greater advantage than immediately about Oughterard. At the picturesque waterfall, near the town, a series of three or four different sandstones appear overlying the syenitic rock, while they, in turn, are overlaid by the beds of carboniferous limestone. At Derrylaura, about one mile N.W. from Oughterard, a coarse red conglomerate,

with rounded pebbles of grey quartz, is found resting on the igneous rock at an inclination of 15°. The division of the two rocks is here far better defined than at the junction near the town, where there appears to be a passage from the sandstone into the syenite. A stream bears along during floods the quartzy pebbles set free by disintegration from the conglomerate; and it is interesting to contemplate the shingle that once rolled on the shores of an ancient sea, now hurried on in the bed of the mountain torrent after its rest of ages. The sandstone here is probably the extremity of a narrow band of that rock that extends under the waters of Loch Corrib to Cong, and rises near that town with a thick covering of its own detritus.

A junction of a different kind may be examined about three miles south from Oughterard, where the beautiful syenitic porphyry abuts against a hornblendic rock, that forms with it a range of hills varying from 600 to above 900 feet in height; from whose summits the greater part of the igneous district of West Galway may be seen, stretching away to the ocean with its sombre covering of heathy moor, and drearily speckled with the leaden tints of its hundred lakes and pools.

I have attempted to show the features of the junction at Oughterard in a plan and diagram section:—

No. 1 is the ordinary limestone, but changing its character at its junction with the sandstone, where it assumes an arenaceous appearance, and becomes full of crystals of calcite.

No. 2 is a bed of yellow sandstone, six feet thick.

No. 3 is also a bed of sandstone, thinly laminated, and full of minute crystals of pyrites, three feet thick.

No. 4 is a bed of quartzose sandstone, four feet thick.

No. 5 is a remarkable rock. It may be called a sandstone conglomerate: but on the surface I found some four-sided pyramids, from two to three inches in height, and more or less perfectly shaped like crystals. These are mineralogically different from the rock itself, and somewhat from each other, assuming in various degrees a syenitic character. They are spotted with pyrites, and contain small crystals, apparently of hornblende. This rock is interesting in a double point of view, as it illustrates the passage of a sandstone into a syenite, and shows a tendency of the latter to form crystalline shapes, which, in this example, enclose smaller crystals of its contained minerals. The pyramids, and, indeed, all the granitic rocks, are covered with a coat of shining black, that reminds one of the incrustations which Humboldt says are found on granites washed by rivers of the torrid zone.

No. 6 is a rock of very varied appearance. In some places it might be called quartz rock; in others it resembles a conglomerate, and in others again it approaches a syenite, into which it finally seems to pass.

The inclination of the stratified rocks increases from 30° at the head of the lower waterfall to 60° at the summit of the upper, and it again decreases to 30° at the junction with the syenite; and it is worthy of remark that the planes of the principal joints of the latter at No. 7 display a conformability with the bedding of the former.

a represents the place of a cliff situate in an island not in the line of section, opposite which the rock in the bed of the river exhibits joints *anticlinal* to No. 7. The cliff is formed of a light-coloured syenite with whitish felspar and green hornblende; and *b* shows the position of a cliff on the side of the fall, similar in mineralogical character to Nos. 5 and 6.

The phenomena I have tried to describe seem to suggest that the syenite here was an altered sandstone, elevated at an axis marked by the meeting of the anticlinal planes of the joints; and I consider the rocks at this junction no less worthy of observation on that account, than for the distinctness with which they show the tendency of a rock mass to assume definite crystalline forms under favourable conditions, which in this case might be attributed to the absence of pressure on the sandstone that had previously been stripped by denudation.

Mr. Kelly made some remarks on this paper, stating that a rock protruded through limestone rendered it dolomitic.

Professor Galbraith dissented from field geologists characterizing dolomitic rocks by colour or crystallization only, as analysis leads us to believe that these characters often lead us astray.

Professor Jukes observed, that the term which should properly be used in speaking of these rocks was not dolomite, but magnesian limestone, as he could instance cases in the experience of Mr. Wyley, in which the presence of magnesia in as small a per-centage as 5 per cent. had been detected by mere inspection alone.

Professor Harkness considered we must believe that dolomitization did not arise from igneous agency, but from forces acting externally to the rock, probably from the action of sea-water at great depth, under great pressure, by means of the decomposition of the sulphate of magnesia held in solution.

The Chairman stated the last opinion had often appeared to him to explain dolomitization as it occurred in this country, but not to explain the great masses of dolomite as they occur abroad.

Professor Galbraith objected to the theory, as we ought to find sulphate of lime along with the dolomite, if it were true.

Professor Harkness thought the sulphate of lime, being more soluble, ought to be carried away in solution.

Professor Galbraith dissented from this solution.

Mr. J. Beete Jukes also read the following paper:—

THE DRIFT OF WEST GALWAY AND THE EASTERN PARTS OF MAYO.

BY JOHN BIRMINGHAM.

Among the geological phenomena of Ireland not the least interesting are the escars, or gravel hills, which are found in all parts of the island. They differ from the drifts of other countries by presenting no fossiliferous testimony of their period; while the similar lines of gravel hills in Northern Europe are proved, by their resting on beds containing

recent shells, to be of very modern origin. The Norfolk drift with Scandinavian pebbles, according to Lyell, also rests, at some points, on a fresh-water bed, with shells of existing species; and in the west of England boulder formation, as well as the drift of Wales and Scotland, are found shells of mollusca that now inhabit our seas. But the Irish escars, so far as hitherto known, neither contain fossils of their own, nor overlie any beds that discover their age. To account for the former circumstances, it would be only necessary to consider the character of their materials, when it would be plain that no shell could have resisted the grinding action of the moving gravel; but this would not so well explain why traces of the lithodomi, which I have always searched for in vain, should be wanting; and we must, therefore, seek a different cause for the absence of shells. I think this may be found in the probable fact that little, if any, of the drift that has been left behind by the waters, ever lay at the surface of the former sea bottom, the upper parts of which have been swept away beyond our ken; and the drift that we now see was derived from rocks that were situated at a depth to which no mollusca ever reached.

The escar drift is well developed in the west of Ireland; and in an extensive district which I have closely examined, in the west of Galway, and the eastern parts of Mayo, I think I have succeeded in discovering evidences of two other drifts. I will now venture to describe all three, giving them distinctive names for clearness sake, and classifying them in the order of succession upwards, as follows:—

1. The clay drift.
2. The great boulder drift.
3. The escar drift.

The movement of the first I believe to have been from a point between the south-east and the west; of the second, from a point between the north and the west; and of the third, from the south-west.

The "clay drift" forms prominent cliffs on the coast near Barna, about two and a half miles S. W. from Galway (Ordnance sheet 93); and similar ones occur at intervals round the eastern and southern shores of the bay to Ballyvaughan, in the county of Clare (O. S. 2). At Barna its great mass consists of limestone boulders and clay; but it is sparingly intermixed with granite, by which general name I will call the various syenitic rocks of Galway; and, at first view, one would see nothing remarkable in the mixture, as the cliffs are situated in a granite country. However, on a closer inspection it is easily perceived that the peculiar species of granites which are found in those cliffs are not the native rocks of the neighbourhood; nor have I found them *in situ* in any part of the igneous district of West Galway. The inference is, that they came from rocks that are still hidden beneath the waters of the bay; whence alone the drift could arrive without containing some of the granites that now form our dry land. But that it did not come from those parts of the bay which lie to the east or south-east, is shown by the drift of the Aughinish cliff (Clare O. S. 3), which is composed of limestone boulders imbedded in a tenacious clay, without a trace of the

sandstones of Slieve Aughta, which lies at no great distance in those directions. Neither is there any granite in this cliff, which corroborates the evidence of the Barna cliffs, that their materials did not come from any northerly source. It is proved, therefore, by the Barna cliffs, that this "clay drift" was not transported from any point of the compass in the north segment contained between the west and east. The Aughinish cliff proves this also, and to that segment adds from the east to the south-east; consequently, it must have been carried from some part of the smaller segment between the south-east and the west; a conclusion that is confirmed by the absence of granite in the drift of Aughinish; but I have found no data that might enable us to define its course more exactly.

The "great boulder drift" has left ample evidence of its progress. The Barna cliffs are strewed over with large granite and limestone blocks, and the granites, which are very different from those in the drift below, are easily recognisable as belonging to the rocks of the district to the north and north-west of Barna. The limestone boulders, which are less numerous, probably came from the district west of Lough Corrib; and some of them present the arenaceous appearance that I have remarked in the limestone about Oughterard near its junction with the granite. At Aughinish, though the drift there, as already stated, is unmixed with granite, still many boulders of that rock from the north-west are found on the surface of the land above. They are smaller and rounder than those on the Barna cliffs; and they may be traced over the country towards Slieve Aughta.

I think the distinction, direction, and sequence of these drifts are all sufficiently proved by the above examples. The distinction and sequence, and, less clearly, the direction, are shown where the boulder drift overlies detached masses of the clay drift in the granite country between Barna and Lough Corrib; as at Tonabrocky Hill, two and a half miles north of the Barna cliffs (O. S. 81); and at Glenlough, three-fourths of a mile N. E. of Tonabrocky (O. S. 82), where the clay drift shows signs of denudation before the deposition of the granitic gravel. The direction alone is proved by phenomena observable throughout the whole district referred to by this paper, and of which I will give a few examples.

At St. Brandon's Island, three miles S. E. from Galway (O. S. 94), we find large igneous boulders, the parent rocks of which lie to the north-west in the vicinity of the town.

About five miles S.W. of Oughterard (Galway O.S. 67), on the road from the village of Doon to Letter, and at less than a mile from the former, is a drift hill containing a large block of sandstone, but chiefly composed of the debris of hornblendic rocks. Leaving the road a short distance farther on, and ascending the hill to the right, the hornblendic rock is discovered *in situ*, covered with great boulders of syenitic porphyry, a characteristic rock with large crystals of flesh-coloured felspar and green hornblende; and this also may be found *in situ* at Knockalee Hill, at a distance of near two miles in a direction rather north of west.

The intervening hill is also covered with similar boulders, but larger, some of them far exceeding one hundred tons, and more angular; and it is worthy of remark that they seem inclined to cluster round the summits of the hills, rather than spread over the valleys between them.

The country adjoining Slieve Dart to the south-east, near Dunmore (Galway, O.S. 5), is full of its sandstones and conglomerates; and I think it unnecessary to cite any more of the various examples I have remarked of this drift, which I have characterized by the name of "boulder drift;" as its distinctive remains consist of the larger blocks that resisted the subsequent force which removed its lighter materials.

The escar drift in the greater part of my district is composed of limestone gravel of various degrees of fineness, mixed in a small proportion with the debris of other rocks. In its formation it is often amorphous, and often shows stratification more or less perfect, in which the coarser gravel and boulders generally incline towards the upper parts,—a fact that I think deserves especial notice, as it appears at variance with recognised geological theory. It might, perhaps, be referred to the action of light currents on the mass of previously deposited drift, the fine sand being carried away to a certain depth, and the larger stones and gravel left behind by a kind of winnowing process, and settling in an accumulation on the surface of the parts undisturbed.

The disposition of this drift would show a force moving towards the north-east, in the southern part of my district, and then assuming a northerly course, which it continued to the coasts of Mayo and Sligo. The lines of gravel hills are favourable in their direction to this hypothesis, which is also supported by their mineralogical evidence. The escars immediately to the south of the sandstone district of Slieve Dart contain little or no gravel of that formation, though its large boulders are scattered over other parts of the land. The southern slopes of Slieve Dart are swept pretty clear of small drift, which, on the northern side, covers, to a great depth, a large extent of country. A felstone dyke occurs at the north-eastern extremity of the sandstone, and its boulders are only found to the north. Its date may be posterior to the "boulder drift," and it may have been contemporaneous with the rise of the land during the escar period.

In the yellow sandstone, Silurian, and porphyry districts about Uggool and Kilkelly (Mayo O. SS. 72, 73, 81, 82), the ranges of escar hills, approaching from the south, contain but few specimens of rocks *in situ* to the north of them; and those were, probably, carried back from southern localities, whither they had previously been carried as "boulder drift." This remark is illustrated by a fine escar formation at Kilkelly, and about a mile east of that town an escar range commences within the sandstone country, and runs for about two miles, rather west of north, to the borders of the porphyry district. It is composed of mixed limestone and sandstone gravel, without containing, as far as I could see, any traces of the porphyry. Within the porphyry district the sandstone drift abounds, and its great boulders are seen close to the summit of the highest hill, at an elevation of near 700 feet above the level of the

sea. The whole sandstone country is full of hills of its own detritus, generally in confusion, but sometimes showing a tendency to lines running east and west, or S. W. and N. E., and with forms elongated in those directions. At Cahir (O. S. 81) limestone drift is found below sandstone at a depth of 20 feet, and may be an example of the "clay drift" underlying the "boulder drift." I have not examined the country farther north; but Mr. Griffith has proved a drift movement there, from south to north, as far as the sea. I may here remark, that eastward from Galway Bay, which would appear to have been the focus of a certain amount of divergence, the gravel hills seem to run in a more easterly direction.

The greatest apparent difficulty connected with the separation of the drifts lies in distinguishing between the "clay drift" and the escar formations; for they might be easily considered as identical and overlaid by the "boulder drift." The following are the reasons that induced me to make the division:—In the first place the "clay drift" of Galway Bay bears only on its surface, and never within it, any materials which can be referred to the "boulder drift;" and the escars, on the contrary, contain, mixed with the limestone gravel, that forms their chief bulk, many mica slates, greenstones, and other rocks, which must have been previously deposited by it, as no formations from which they could be derived lay in the course of the escar drift. In the next place, I think that the separation is justified by the appearance of the escar hill-chains, whose long unbroken lines suggest the idea that the force which shaped them was the last that passed over the surface of the present land; and as the "boulder drift" was subsequent to the "clay drift," so the escar drift was posterior to the former, which intervened between both the others.

Though I believe that we have thus sufficient data to prove the existence of three great drift periods in this district, still there are many deposits which it would be impossible to refer distinctly to any one of them. Beneath the alluvial flats, where our rivers run slowly in a deep channel, we often find a stratum of rounded boulder-stones imbedded in blue or yellow clay, and differing in that respect from the materials of the escars, which never advance beyond the borders of those plains. The rounding of the boulders is certainly not to be attributed to the action of the river itself at any period; for we have no reason to believe that the waters ever moved with greater velocity in those parts than at present, but rather less; for above the boulders there is generally a stratum of marl, and on this, the surface layer of alluvial soil, both containing shells of the most delicate structure, in so perfect a state of preservation as to convince us that they must have been deposited in almost still water. These shells are all recent, including the genera Planorbis, Lymnæa, Succinea, Paludina, Cyclas, &c., mixed with land shells; and their inhabitants must have lived at a time when the river was rather a succession of lakes, joined by narrow straits, before its waters cut a deeper way through the barriers that opposed their course, and, with a diminished breadth and reduced level, formed a channel through the lowest part of

their own previous deposits. But this formation exists in situations far removed from any rivers, and it often forms the subsoil of our higher lands. In the limestone country its boulders and gravel are chiefly limestone; but it contains in a greater proportion than the escars a mixture of Silurian and other sandstones, mica slates, greenstones, and sometimes granite; and indeed it is, probably, from the decomposition of those rocks that the blue and yellow clays which it contains are derived. The greater part of these beds and accumulations may have been originally deposited as boulder drift, and afterwards disturbed and mixed with new matter at the escar period. To the escar movement may be attributed the deeper soils and superior fertility of our greater hills on the north than on the south side.

Having explained my opinions, and the reasons on which they are founded, regarding the proper separation of our drifts into three great divisions, the places they occupy in relative position, and the directions in which they moved, I will now state my views as to what the force may have been by which those remarkable effects were produced. Two theories have been proposed,—one of which would make water the moving agent, and the other ice. The latter is the latest, and has the recommendation of novelty in its favour, besides the more substantial one of being the adopted of Agassiz.

It may be with the geologist as with the painter or the musician, in whose works, though they speak the universal language of genius, a national accent can still be noticed; and the ice or water theories may, to a great extent, owe their origin to the physical circumstances of the native countries of their proposers. An inhabitant of Switzerland who has been accustomed to observe the vast power of the glaciers grinding away the sides of mountains, scooping out their bed in the granite rock, and carrying the fragments of fallen peaks on the crests of their solid waves, must see that ice is indeed a great agent in geological phenomena; and, on the other hand, to a native of our western isles who has been viewing the Atlantic from his childhood, and has seen cliffs pulled down, and the huge masses of their debris tossed about by the surge, the force of water will be considered unsurpassed. One, as correctly as the other, might found a theory of limited applicability on the great power that he had been used to contemplate; but they would be equally wrong in seeking to give it too great a generalization.

I believe that Agassiz, though not the inventor of the glacial hypothesis, was the first who conjectured the former existence of glaciers in the British Islands, and it would be far from me to question the correctness of that great man's opinion, supported as it has been by our own most eminent geologists; but in the district to which this paper refers I believe that it is neither to land glaciers nor floating ice, but simply to the moving force of water, that we must attribute the phenomena of drift.

Nothing can be more marked than the increase in number, as well as in size and angularity, of our boulders as they are followed to their source; and my knowledge of that fact has often assisted me in tracing

them to their parent rocks, which are all to be found within a moderate extent of country. Their *decrease in number*, according to the remoteness from their native localities, might, indeed, be accounted for on glacial principles; but not so easily their *diminished size:* for though the ice-raft may waste away by degrees, and its powers of buoyancy become less, still this must be thought to effect the *total quantity*, rather than the *individual parts* of the load that it bears. As its cliffs succumb in its progress through the warm sea-waves, its burden may gradually be reduced; but there is no reason why the largest masses should not still be found among the mixed materials that are carried on its contracting area. If, to meet this objection, the inveterate glacialist would have recourse to the manipulation of various icebergs for the shaping of each diminished boulder, asserting that its reduced form was due to the lines of bedding, or divisional joints of the original mass, which rendered it liable to split into fragments when alternately let fall and taken up by successively advancing icebergs,—he may be told, that however applicable his explanation might be to the erratics of other regions, the short-travelled boulders of our district will be more simply, and therefore more probably, accounted for, by conceding, in this instance at least, the motive power to the ordinary waves and currents of the sea.

If ice were the transporting cause of our drift, we should expect to see scattered over the surface of the land even a few large blocks that escaped those conjectured vicissitudes of the smaller in their journey from distant localities; but they are never found so situated. The great boulders must be looked for near their source, and we have nothing like erratics of 100 tons, whose route must have been 100 miles or upwards.

I have already alluded to the unbroken lines of escar hills as a proof of their subsequency to the other drifts, and it is hard to imagine how they could escape the levelling action of icebergs, had these been floating about and impinging against the shores at the time of the final rise of the land. Of course, this remark applies also to Scandinavia and to other countries; and generally I would say, that the existence of escar chains seems to suggest the prevalence of a climate unfavourable to icebergs at the period of emergence from the waters; and this was precisely the time when I believe that the escars were formed.

Though the striation of rock-surfaces which I have observed in some parts of my district may be thought indicative of glacial action, still it does not follow that we must refer to that cause the various phenomena of the drifts. The comparatively local character of those deposits which I have alluded to above is unfavourable to such an idea; and the stratification that the drift so often shows is a proof that, however it had been originally accumulated, it comes finally under the action of the waves and currents, so that its present condition, or that with which we have to deal, must in any case be attributed to aqueous causes. At the same time, I do not think that the parallel striation of surface rocks can always be so confidently ascribed to the operation of icebergs. On account of the probable unevenness of the sea bottom, it is likely that when an

iceberg began to touch the ground, it would strike it on a surface of very small extent at a time. The greater portion of the berg would be afloat; and as this, of course, would yield to the action of the waves more than the part aground, the result would be a curvilinear motion of great irregularity, and subject to constant alteration as the iceberg advanced and struck ground in other parts; and even if a portion of it were absolutely afloat, the prominences of the bottom would form temporary centres of revolution as it was thrust forward. From this I should expect very great confusion in the tracks of icebergs over an extended area, and but little similarity between them and the markings of a glacier on dry land, where the even motion is derived from quite different causes. The scorings that I have observed in my district correspond with the lines of escar hills, and show for many miles an unchanged direction from S.W. to N.E. The polished ends of the rocks face the south-west, and show that the movement, like the escar drift, proceeded from a quarter unfavourable to arctic conditions. Might not the surface striæ be referred to the rubbing of large flat masses of boulder rocks, which were pushed forward by the waves before they became sufficiently rounded to roll? It would be no wonder that the lines, thus engraved, should everywhere betray the direction of the single force that caused them, or, in other words, be parallel to each other.

If my reasons for rejecting the floating-ice theory, as applicable to the drifts of my district, be considered of any weight, I may object, with great confidence, to the land-ice hypothesis. The escar chains bear little resemblance to moraines, the character of which I have observed closely in the Alps, and the drift that has ascended to higher levels was certainly not borne on sliding glaciers.

Still I must not be considered as disputing the possibility, or even probability, of the prevalence of a glacial climate here at some comparatively modern period of the earth's history. It is easy to conceive that a time may have been when the disposition of land and water in the northern hemisphere was similar to what it is at present in the southern, and that loaded icebergs may have come down from a great arctic continent to latitudes even south of Great Britain and Ireland. But whatever opinion we may form on this point, my impression is that the drift deposits under consideration do not show any structure or phenomena which cannot be more easily ascribed to the simple action of water than to the agency of those frozen rafts. We may leave the far-travelled erratics of other countries to satisfy the demands of the glacialist; but I must claim the formation of at least our Galway and Mayo drifts for the liquid force of the ocean; and I will now try to explain how I think they could be derived from the force of currents and breakers without the intervention of ice.

I will begin with the "boulder drift," which I believe was deposited during a sinking of the land. I am aware that Mr. Darwin has written on the ascent of hills by boulders; but I have not seen his paper, and cannot tell how far his views may agree with or differ from the following:—

As the subsidence took place, the breakers pushed before them the masses that they had riven from the cliffs, breaking many into fragments, and rounding them as they progressed with the advancing boundary of the sea. In this manner was effected the transit of boulders, continually decreasing in size over the face of the submerging country; and thus, also, were the blocks driven up the hills while these went down progressively below the water line. But while the breaker action on the surface directly exposed to it would tend to drive the drift towards the dry land, or upwards, the currents would produce a contrary effect, and, running deeply, and with great force, among the submerged hills, they would carry the smaller drift down their sides, and bear it along to a distance. On the sides of the hills not fronting the force of the waves, these would also drive the drift downwards, but only to the extent limited by the trifling depth that can be reached by breaker-action; and by this separation of the effects of breakers and currents, the course of the latter during a period of submergence might be inferred from the drift that has come from distant and higher levels, if not subsequently disturbed, and the direction of the prevailing winds may be conjectured from the great boulders about the summits of hills. Accordingly, we have grounds for concluding that at the time of the "boulder-drift" currents the predominant winds were not far from due west. The tendency of the large blocks to gather round the summits of the hills shows that the latter existed at that period, and it may be, that few considerable changes in the relative levels of the district have occurred since. During the re-emerging of the land, the forward motion of boulders under breaker action would be continuously down hill on the sides not opposite to the force, but on the side opposed to it the great boulders of a former period would be little changed in position. They could not now be rolled any further up hill, as the sea was retreating; nor would they be carried down the slope, which would be a motion of advance against the force, and to the extent of the excess of length that the ordinates towards the base of the hill would have over those towards its summit in a curve of its vertical profile. Thus the great boulders of the submerging period have, in certain situations, been left as its memorials; in other places the drift of that time was subsequently swept away, and portions of it now represent the escar drift, in which we find materials, as before stated, mixed with the prevailing limestone gravel, that lie at various points between S. E. and N. E. from their sources, according to the distance that they were carried away from their first resting-place where they had been deposited as boulder drift. In consequence of this displacement it is difficult to define the course of that drift within many degrees of its true direction, but we can scarcely err in saying that it came from some point between the north and west. At the same time it is possible—though the probabilities do not seem favourable to the supposition—that the portions of the "boulder drift," which have come from higher levels may have been first removed during the emergence of the land early in the period of the escar drift, and that subsequently a change in the direction of the cur-

rents took place. In this case the boulder history of the previous submergence would refer only to the direction of the prevailing winds, and not to that of the currents.

The granite boulders on the Barna and Aughinish cliffs, already noticed, are, probably, the representatives of a thick formation of overlying "boulder drift;" and they may have reached their present position, returning to the vicinity of their parent rocks, and at the same time sinking through the diminishing mass of smaller materials borne away by the escar currents.

It would be idle to enter into any minute details of the various phenomena of the drifts. My object is, to explain the conclusions which the study of their principal features has suggested. These are sufficient to distinguish them from each other, and, as I believe, to show that the supposed agency of ice, as opposed to water, cannot simplify their formation in our eyes, but, on the contrary, must render it more difficult to be understood. It is to be remembered that, if parts of the drift show a confused arrangement of their materials, others are stratified; and, instead of arguing from the former that it must have been deposited from ice, it should rather be concluded from the latter, that stratification is not always the result of the action of water; and that conditions may exist which would prevent water from giving the orthodox regularity of bedding, which preconceived notions would lead us to expect. Indeed, I have remarked, as a general rule, that where fine sand occurs, stratification is sure to be found; and its absence is chiefly noticed in coarse gravel and tenacious clay, which often form the great bulk of the drifts.

Now, as a *summing up*, I may briefly state my belief that the clay drift was deposited during an emergence of the land; the boulder drift during a subsequent submergence; and the escar drift at its re-emergence.

I think that the general contour of the country in the north of Galway and adjoining parts of Mayo shows the occurrence of great denuding action from the east at a period anterior to the drifts. The shapes of the hills are, in most cases, elongated in an easterly and westerly direction; steep on the north and south sides, and eastern end, and stretching away to the west in a long declining ridge. The rock often appears, or nearly approaches the surface, at the eastern acclivity; and throughout all the district I have remarked that, generally, the rise of outcropping strata is towards the low lands, proving them to be valleys of denudation where the upheaval and disturbance of the beds rendered them liable to be carried away. A grand illustration of this phenomenon may be seen on the Burren Mountains, south of Galway Bay. Long lines of platforms ascend their sides like stairs of giants; and in these the geologist will not fail to recognise the beach-terraces of an ancient sea, made during pauses in the building process of man's abode. Those terraces have a dip that corresponds with that of the strata; and this may be observed on the eastern and western sides of the hills. Its direction is southerly, towards the mountain group, so that the elevation is towards the valley of the bay, and the low country to the east.

I have thus attempted to describe the drift of rather an extensive district; and to explain the ideas which its appearances have suggested. In rejecting the glacial hypothesis in its particular case, I know I shall have few supporters; for the adoption of the ice-theory has been so general that it is esteemed nothing less than a geological sin to *think* of any other; and even I myself was so impressed with the popular respect for it that I began my examinations with strong prejudices in its favour. By degrees, however, I became convinced that every force connected with drift need not, by any means, like *Kabibonoka*,

"Have its home among the icebergs;"

and, while difficulties exist in the way of attributing everywhere to glacial agency the formation of superficial deposits, the objections to an aqueous theory chiefly arise from misconception of the action of water, and ignorance of its real motive power in currents and breakers.

If I fail to convince others of the correctness of my views, my remarks may at least have the effect of drawing more attention to an interesting division of our geology than has hitherto been bestowed on it; and, in the final approval or rejection of my opinions, I hope equally to attain my object, which is the discovery of truth.

I must consider it unfortunate that the eminent compiler of our Geological Map, Mr. Griffith, has not studied the drift formations with the same assiduity that, in the case of the solid strata, has made him distinguished by important discoveries. At the same time, he has not been wholly inattentive to the former; for, in certain parts of Ireland, he has noticed a drift from the north-west, corresponding, probably, with what I have called "the boulder drift" in my district; and to the north of that country he has proved the existence of a southern drift, whose great boulders, rolled down the northern slopes of the Ox Mountains, as well as the gravel hills running south and north at Killala, seem to complete the evidences of the escar movement to the sea.

I cannot conclude without expressing my regret at the general want of appreciation of Geological Science in the country, and the apathy manifested with respect to a subject which equally concerns the philosopher and the practical man, and ought to be so valued by him who loves to worship God in the contemplation of his works. If the study of worlds through space can exalt our ideas of Omnipotence, not less edifying are the revelations of divine wisdom in the structure of the globe we inhabit; and, when the astronomer would address Heaven with his face towards the stars, the geologist may pray looking downwards; nor need piety seek sublime aspirations beyond the ruin-built temple of the earth. But we may hope that the advancing taste for knowledge may lead to a more just estimation of Geology, whose history, read from wasted monuments, presents, indeed, many an unlettered space: yet those dim intervals only add to its sublime interest, heightening the charms that invest it, like the shadows of summer clouds chequering the mountain landscape with beautiful darkness.

Professor Jukes instanced cases in England in which large blocks of rock had been carried from south to north, probably by secondary currents to the north.

Mr. J. Beete Jukes read a paper by M. Alphonse Gages, Curator of the Museum of Irish Industry—

ON PSEUDOMORPHIC TREMOLITE INCRUSTED WITH CARBONATE OF LIME AND MAGNESIA, BEING APPARENTLY THE MINERAL DESCRIBED BY DUFRENOY, UNDER THE NAME OF MIASCITE.

In the supplementary part of his "Traité de Minéralogie," vol. iii., p. 770, Ed. 1845, M. Dufrénoy has described, under the name of Miascite (Miaskite), two very distinct substances.

The first is a grayish felspathic rock, composed chiefly of felspar uniaxal mica and elæolite. It was first described by G. Rose in the account of the journey of Humboldt, Ehrenberg, and G. Rose, to the Ural Mountains.

The name of Miaskite was given to this rock from its occurrence in the hills in the neighbourhood of Miask, in Siberia.

The second substance described under the name of Miaskite was also derived from the same locality just named, whence it was sent to M. Adam. M. Dufrénoy examined it, and considered it to be dolomite.

In examining the collection of minerals in the Museum of Irish Industry, I found a specimen labelled "Miaskite," and answering perfectly to the description given by Dufrénoy of the substance examined by him.

The remarkable structure of this mineral, formed as it were, of a series of crystalline fibres arranged parallel to one another, may be compared to a bundle of flax or of thread, completely incrusted with saline matter, the crystals of which have disposed themselves in the direction of the fibres. This peculiar structure gives it the aspect, at first sight, of fossil-wood, but a close examination led me to suspect that it was the result of pseudomorphic action. Having removed a fragment of the external part of the specimen by splitting it in the direction of the fibres, I introduced it into very weak hydrochloric acid; the result obtained after some days of contact with the acid confirmed my supposition: the acid dissolved a quantity of lime and magnesia, and left an asbestos-like skeleton.

Having submitted another portion to analysis, the following numbers were obtained as the result:—

Carbonate of lime, ...	57·483
Do. magnesia, ...	40·510
Sesquioxide of iron and alumina, . .	0·375
Asbestiform skeleton, ...	1·595
Water and organic matter, ...	0·239
	100·202

If we deduct the iron, water, skeleton, &c., and calculate the relative proportions of carbonate of lime, and of carbonate of magnesia in 100 parts of the mixed carbonates, we obtain the following results:—

Carbonate of lime, ...	58·660
Do. magnesia, ...	41·339
	99·999

True dolomite, or $CaO, CO_2 + MgO, CO_2$ would give the following composition in 100 parts:—

Carbonate of lime, ...	54·201
Do. magnesia, ...	45·798
	99·999

The mineral analyzed may, therefore, be considered as a mixture of dolomite and calcite in the following proportions:—

$CaO, CO_2 + MgO, CO_2$, ...	90·262
CaO, CO_2, ...	9·738
	100·000

The insoluble skeleton, when dried, had the appearance of an asbestiform Tremolite, and its analysis gave the following result:—

Silica, ...	68·181
Magnesia, ...	28·909
Alumina and traces of iron, . . .	2·181
	99·271

It is probable, therefore, that this skeleton was Tremolite, from which water impregnated with carbonic acid had removed the whole of the lime. Thus, if we deduct the per centage of lime, and calculate the remaining numbers in 100 parts in the analysis specimen of Tremolite from Wermland, made by Bonsdorff, and compare the results with the preceding analysis of the skeleton, we shall get the following numbers:—

	Tremolite from Wermland, analyzed by Bonsdorff.	Tremolite, supposing the whole of the lime removed.	Asbestiform skeleton.
Silica, ...	59·75	69·565	68·181
Lime, ...	14·11		
Magnesia, ...	25·00	29·107	28·909
Protoxide of iron, .	0·50	0·582	
Fluorine, ...	0·94	1·094	
Water, ...	0·10	0·116	
	100·40	100·464	

The water which exists in the mineral evidently belongs to the skeleton; but as its quantity could not be absolutely determined, owing to the presence of organic matter, I have not attempted to calculate a formula for the asbestiform skeleton.

Another explanation of the origin of the skeleton suggests itself, namely, that the mineral was not hornblendic, but augitic; for example, like the asbestiform Diopside from Zillerthall, examined by Meitzendorf, when augitic minerals are acted upon by water containing carbonic acid in solution, the lime is removed, and nearly the whole of magnesia is left behind, of which the Rensselverite of Beck is an example.

Numerous other examples of this kind have been given by Beudant, Svanberg, &c.

The organic matter noted in the analysis appeared to have been derived from infiltrated waters, and followed the direction of the fibres. When a fragment of the mineral was heated in a small glass tube, the junction of the fibres was well marked by black lines from the charred matter. Whatever may have been the original mineral, it must have been considerably modified before the incrustation began. The proportion which the skeleton bears to the whole mass of the mineral in its present form is so small, that some of the original fibrous mineral must have been wholly removed before the remainder began to be incrustated.

The peculiar character of the pseudomorph, especially if we assume that it was Tremolite, which is so frequently found in calcareous rocks, suggests the idea that many of the fibrous varieties of dolomite may have been formed in a similar way. It would be worth while to examine some specimens of these dolomites from this point of view.

The Meeting then adjourned to the second Wednesday in February.

ANNUAL GENERAL MEETING, FEBRUARY 10, 1858.

Gilbert Sanders, M.R.I.A., in the Chair.

The Society met at 2 o'clock, when the following Report from Council was submitted and adopted:—

REPORT.

Your Council have much pleasure in congratulating the Society on the amount and quality of the work done during the past year, and on the position of the Society at the present time.

The addition to the number of Members consists of four Life Members, and sixteen Annual Subscribers, making a total of twenty; from which, however, eleven must be deducted, as lost from death and other causes, leaving a balance of nine Members gained during the past year.

Among the Undergraduate Associates, indeed, who last year numbered twenty-one, there is a loss of seventeen, either from their having become Graduates, or from other causes, while only one new Associate Member has joined the Society. As this class of Members is necessarily

a temporary and fluctuating one, it has been thought better that, for the future, their election should be for the session only, and that their numbers should not be included in those of the permanent Members of the Society.

The Members of the Society now, as compared with the corresponding numbers at the close of last year, will stand as follows:—

	1857.	1858.
Honorary Members, ...	4	4
Honorary Corresponding Members . .	3	3
Life Members, ...	52*	58
Annual Subscribers, ...	86*	90
	145	155

Omitting the Associates, the Society seems to be regularly enlarging the numbers of its Members at the rate of about ten per annum.

Among the Members lost to the Society, the one most deeply to be regretted is Robert Ball, LL. D., formerly Secretary and President of the Society; whose sudden and lamented death deprived us, in common with the whole scientific public of Dublin, of one equally characterized by intellectual ability, high personal character, and kindly disposition, and who had for many years rendered services of the highest value to the Society.

Among our other losses are some who, having paid their arrears of subscription, have, to our regret, withdrawn from the Society, and others whose names have been removed from our books in consequence of those arrears not having been paid. Your Council will not seek to conceal from you that there are still retained on the books the names of several persons which must, in like manner, shortly be removed if those arrears are not paid up.

They have no doubt that these arrears of unpaid subscriptions are the result of oversight in the first instance; and would observe, that it would greatly conduce to the welfare of the Society if the subscriptions were always regularly paid soon after they became due.

Your Council have much satisfaction in calling your attention to the soundness of the financial condition of the Society, owing to the strenuous efforts that have been made to reduce the expenses; remarking, however, at the same time, that increased funds would enable them to increase the value and utility of the Society both to the Members and to the public.

Your Council would congratulate the Society on the change of their place of meeting, and call your attention to the far greater comfort and convenience with which the Evening Meetings are now held than formerly. They desire to record, on their own behalf and that of the Society at large, their sense of obligation to the Board of Trinity College, for the permission to hold their Evening Meetings in the new

* One of each of these classes was omitted by mistake last year.

buildings, not forgetting the debt of gratitude due to their old and valued Vice-President, Dr. Lloyd, for having so long afforded us the use of his rooms for all the purposes of the Society, and for still continuing to do so for the Meetings of the Council, and the place of deposit of the Library.

A slight change has been made in the By-Laws of the Society during the past year, the effect of which is,—

1st. To allow Annual Subscribers to pay either an entrance fee of £1 and an annual subscription of £1, or an entrance fee of £5 and an annual subscription of 10*s.*; and—

2ndly. To enlarge the term from one month to sixty-three days, during which a non-resident Life Member may reside within twenty miles of Dublin, without being liable for his annual subscription; and to reduce such annual subscription, when due, from £1 to 10*s.* It is also proposed that any Annual Subscriber who has paid an entrance fee of £5 may at any time compound by a further payment of £5 for his annual subscription of 10*s.*

The ballot was then opened, and the following declared duly elected:—

President.—Rev. Professor Haughton, M. A., F. T. C. D., M. R. I. A.

Vice-Presidents.—James Apjohn, M. D., M. R. I. A.; Professor Harvey, M. D., M. R. I. A., F. L. S.; Rev. Humphrey Lloyd, D. D., S. F. T. C. D.; Sir Richard Griffith, Bart., LL. D.; Lord Talbot de Malahide, F. R. S., M. R. I. A.

Treasurers.—Gilbert Sanders, Esq., M. R. I. A.; F. J. Sidney, LL. D., M. R. I. A.

Secretaries.—J. Beete Jukes, M. A., M. R. I. A.; E. Percival Wright, M. B., M. R. I. A.

Council.—Robert Mallet, C. E., M. R. I. A.; Edward Wright, LL. D., M. R. I. A.; Robert Callwell, M. A., M. R. I. A; Rev. J. A. Galbraith, F. T. C. D., M. R. I. A.; John Kelly, Esq.; George M'Dowell, M. A., F. T. C. D.; Samuel Downing, C. E., LL. D., M. R. I. A.; John B. Doyle, Esq.; Dominick M'Causland, Esq.; John R. Kinahan, M. D., M. R. I. A.; G. V. Du Noyer, M. R. I. A.; Alexander H. Haliday, M. A., M. R. I. A., F. L. S.; Rev. Joseph Carson, D. D., F. T. C. D., M. R. I. A; Alexander Carte, M. A., M. B., M. R. I. A.; John Ball Greene, Esq.

The Society then adjourned till 9 o'clock.

ADJOURNED ANNIVERSARY MEETING, FEBRUARY 10, 1858.

Lord Talbot de Malahide in the Chair.

The following addition to the By-Laws was proposed and adopted:—

"Any person residing as above, who shall have paid an admission fee of £5, shall be at liberty to compound for his annual subscription of 10*s.*, by the payment of a further sum of £5."

Charles Cotton, Esq., University Club, Stephen's-green, was proposed by Professor Haughton, and seconded by Professor Galbraith.

Lord Talbot de Malahide then read his Annual Address, at the conclusion of which he retired from the Chair, which was then taken by Professor Haughton.

A vote of thanks to Lord Talbot for his distinguished services to this Society during his Presidency was moved by Dr. Apjohn, which was seconded by Professor Galbraith, and carried by acclamation.

Dr. Wright moved, and D. M'Causland, Esq., seconded, that the Address be printed. Carried.

The Society then adjourned to March.

ANNUAL ADDRESS.

Gentlemen,—Our Society was formed in 1831, and has continued ever since with varied fortunes, but with a constant accession of scientific strength. I believe I can congratulate you on the prospect of increased efficiency, and of a larger sympathy on the part of the public. I feel it a high honour to have been elected for three years to fill this Chair, particularly as it fell within my functions to preside at the Geological Section of the British Association during their meeting in this city, one which has equalled most of its predecessors in brilliancy and interest. However, it is right that a change of officers should take place, and I rejoice to find that so distinguished a philosopher as Professor Haughton has consented to act as President during the current year. Although my other vocations may prevent me from attending the meetings as often as I could wish, I shall always be most anxious to watch the progress of the Society, and to assist it in every way that lies in my power. The Report of the Council contains all the statistical facts relating to our numbers and our finances; and here I shall confine myself to urge upon every member the importance of his acting as a recruiting-sergeant to enlist all likely persons,—not holding out to them, however, a reduced standard, but the prospects of glory in the fields and battles of our warlike science.

Fortunately, we have not to deplore the loss of so many of our members as during the last year; but there is one which I cannot pass over without enlarging somewhat upon this melancholy theme, as he was one of our oldest, most zealous, and useful friends. For many years I have been on terms of intimacy with him, and to him I owe what interest I have taken in the pursuit of Zoology.

Dr. Ball was a native of the county of Cork, and thanks to his friend, Mr. Robert Patterson, we have a detailed account of his career in the last number of the "Natural History Review." I shall, therefore, on the present occasion be more brief than I should otherwise have been.

He was born at the Cove of Cork, in 1802. His family lived at Youghal, and there he spent those parts of his youth which were not devoted to school. He appears to have been a self-taught naturalist, and Mr. James White, of Ballitore, at whose school he was principally instructed, encouraged this propensity. It is much to be regretted that he was not

enabled to follow some independent profession, instead of being bound during all his active life by the trammels of office. He doubtless could have distinguished himself in almost any line. It was through the influence of his kind patron, the late Duke of Devonshire, he obtained, in 1827, the clerkship in the Castle of Dublin, which he retained until his superannuation in 1852. A more indefatigable public servant never existed, nor one more intelligent and faithful to his trust; and I venture to say that there is not a more disgraceful specimen of the bureaucratic style than the following sentence:—Mr. Ball is placed on the retired list on the ground "that he devoted much attention to scientific pursuits, and that it was not expedient that public servants should be thus occupied." Before this time, and subsequently to his superannuation, he was busily engaged in other public departments that had not the same antipathy to science. In 1851 he was appointed Secretary to the Queen's University; in 1854, Secretary to the Joint Committee of Lectures; in 1855, Assistant Examiner for Ireland to the Civil Service Commission; and he continued this arduous duty till the close of his life.

He acted as Secretary to the Dublin Zoological Society for more than twenty years, and it is mainly owing to his exertions that this useful body was kept alive during the years of famine and difficulty, amid the apathy of the Irish public. It must have been a heartfelt gratification to him to see it placed at last on a secure and firm basis by a small Government grant of £500 a year, which it at present receives.

In 1853 he was the founder of the University Zoological and Botanical Association, which has been so useful a recruiting body of young and zealous naturalists.

Dr. Ball was elected a Member of the Royal Irish Academy in 1835, and a Member of Council in 1838. He acted for many years, and died Treasurer of that distinguished body.

He was elected a Member of the Royal Dublin Society in 1834, and in 1854 a Member of Council; he was also a Member of the Council of the Statistical Society from its foundation in 1847.

He joined our Society in 1835, and was always an active member. In 1837 he was elected on the Council, and in 1852, President. We are also greatly indebted to him for his unremitting support during those dreadful years when society itself seemed rocking at its base. His extensive knowledge of Natural History was of great value, particularly when Palæontology assumed its proper position as the right-arm of Geology. His courtesy and affectionate demeanour to all was most remarkable, and only to be equalled by his great modesty. In the "Journal" of our Society he wrote occasionally in illustration of those questions where Natural History throws light on Geology; but it is much to be regretted that he had so little time and leisure to mature and perpetuate the information with which his mind was stored.

It was chiefly through his exertions that we were induced to offer our Collection to the University of Dublin. It now forms the nucleus of that noble Museum. Dr. Ball was appointed Curator, and during many years devoted a considerable portion of his leisure to its classifi-

cation, and the preparation of numerous valuable specimens and casts. The skeletons of the *Cervus megaceros* are the most complete in existence, and evince his great skill in the art of museum arrangement.

He was appointed President of the Zoological Section of the last Meeting of the British Association; but it was not the will of God that he should witness another meeting of that body. He died suddenly on the 30th of March, and most of us had the melancholy pleasure of accompanying his remains to Mount Jerome Cemetery.

He has left a chasm in our ranks which will not be easily filled. May his surviving family enjoy every kind of prosperity, and may his sons follow in his steps!

I think the most convenient course for me will be to notice briefly the most remarkable papers which were submitted to our Section of the British Association. There are some few notices of a general nature which I may introduce in a separate paragraph, and I will reserve to a later period the discussion of some of those intestine questions which have produced so much interest on this side of the channel. I do not conceive that I am called on to give anything like a general view of the progress of Geology in other countries, as we know the conscientious manner in which the present President of the London Geological Society discharges this arduous duty.

As far as Geology was concerned, we have every reason to be satisfied with the intellectual fare which was provided for us. There was a goodly gathering of congenial spirits; and although, to my deep regret, we missed the well-known and revered faces of Buckland, of Delabeche, of Conybeare, of Greenough (who no longer belong to this earth), and also of a Sedgwick, a Murchison, and a Lyell, we were gratified with the opportunity of making the acquaintance of many of the young and rising followers of the science, and some of the celebrities of America and Continental Europe. Above all, it must have afforded you all the sincerest pleasure to welcome again to these shores General Portlock and Mr. Oldham, who both filled this Chair with such success, and who now, as you are doubtless aware, are respectively placed in the honourable and responsible situations of President of the Royal Geological Society of London, and Director of the Geological Survey of India.

We have been honoured by the visit of Messrs. Schlagintweit, who have been so long engaged under the King of Prussia and the East India Company, to their mutual honour be it spoken, in investigating the natural history and physical peculiarities of India; also, of the two Professors Rogers, who have imparted to us such valuable and novel information on the geological structure of the United States of America, particularly in relation to the Geological Map of Pennsylvania which has been prepared under their direction; and Professor Mallet, who has exhibited and explained that truly masterly production, the Geological Map of the State of Alabama.

Mr. Fox's paper on the "Temperature of Mines," forms the sequel to a series of observations, which, for the last twenty years and upwards, has occupied his attention. It is truly refreshing to see such long sustained perseverance in the pursuit of scientific truth.

Sir Roderick Murchison, though not with us corporally, has sent us a valuable paper on the crystalline rocks of the N. W. Highlands, which he proves on fossil evidence to be of lower Silurian age.

Professor Harkness continues his observations on the triassic formation of the south of Scotland and N. W. of England, which appears to harmonize more with the continental deposits than any other within these isles. He also read papers on the lower sedimentary rocks of Cumberland, and on the dolomitization of rocks in the vicinity of Cork.

Professor Phillips gave us one of his graphic sketches of the ironstone beds of the Olites of Yorkshire.

Professor W. B. Rogers exhibited some good photographs of that peculiar and characteristic Palæozoic fossil, the Paradoxides.

I beg to call your particular attention to our member, Mr. Robert Mallet's "Report on Earthquakes." He has for many years studied these phenomena, and explained them by those great cosmical theories to which the powers of analysis and pure mathematics have been so successfully applied. We must all rejoice to hear that he has been dispatched, under the sanction of the Royal Society, to inquire into the circumstances attending the almost unexampled physical disturbances in Southern Italy.

Another great question in Physical Geology, the subject of slaty cleavage, has also been well discussed. Professor Sedgwick and Mr. Sharpe have long since propounded theories to explain these properties of rocks. But it is only within a recent period that the Baconian system of induction has been systematically brought into action in order to afford a rational solution of them. Mr. Sorby has most minutely examined slaty rocks under a powerful microscope of 400 linear, and he comes to the conclusion that pressure in a direction perpendicular to the direction of the cleavage planes is sufficient to account for these problems. He observes:—"In cleaved rocks, whether we examine the diminution in distance between any two points lying in the line of pressure in contorted beds, the dimensions of the beds in different parts of contortions, the organic remains, the green spots, or the very minute rounded grains of mica, we find most conclusive evidence of an elongation in the line of dip of cleavage, and of a great compression invariably in a line perpendicular to the cleavage."

Professor King has also confirmed this view by comparison with the views observed in crystallized minerals.

Professor Haughton also has come to a similar conclusion, by a study of the distortion to which fossils are so frequently liable in slaty rocks; he has accurately measured the angles which they form to the planes of cleavage, and has thence deduced the following laws:—

1st Law.—If the trace or intersection of the plane of cleavage and plane of bedding be drawn, the greatest distortion or elongation of the fossils lying in the plane of bedding is parallel to this intersection.

2nd Law.—The distortion of fossils produced by cleavage, estimated in a given direction, such as parallel to the intersection of the planes of cleavage and bedding, varies with the angle between these planes, being greatest when the angle is greatest, and least when the angle is least.

3rd Law.—The compression in a cleaved rock is greatest in a direction perpendicular to the planes of cleavage.

These positions are illustrated in the Rev. Professor's papers by some very interesting drawings of distorted fossils from the Carboniferous Limestone.

Professor H. D. Rogers, however, does not entirely subscribe to these views, for in a learned paper by him, published in the Transactions of the Royal Society of Edinburgh, "On the Laws of Structure of the more disturbed zones of the earth's crust," he adheres rather to the theory of Professor Sedgwick, and conceives that "cleavage is a change brought about by the parallel transmission of planes or waves of heat, awakening the molecular forces and determining their direction."

Mr. Hopkins has also contributed some experimental researches on the conductive powers of various rocks, and the bearing of the results upon theories of terrestrial temperature. It is by the accumulation of such facts as these that we shall ultimately be led to the construction of a true and philosophical theory of the earth.

It is satisfactory to find one of our Professors, Mr. Hennessy, grappling with one of these arduous questions of mixed mathematics, and attempting to calculate the forces capable of changing the sea-level during different geological periods. Arguing on the supposition that the crust of the earth underwent a change of volume on the gradual cooling of its surface, and that a change of the ellipticity would be the consequence, he concludes that a very considerable alteration of the sea-level would be the inevitable result.

Mr. Oldham gave us a general view of the geology of India. It is a gigantic subject, and the great scale on which the principal formations in that country are to be seen must ultimately be most important to the progress of our science. We are under the greatest obligations to the late Mr. Greenough, one of whose last works was the publication of his Map of India; like the similar Map of Great Britain, it will form the groundwork for all future inquirers. But in so vast a country, and one which contains so many large tracts, as yet but little known to the natives themselves, it will require many years of careful exploration before the true nature and extent of the different strata can be accurately determined. Mr. Oldham's work has, doubtless, been arrested by the deplorable events which have recently occurred in that country, but we must hope that general tranquillity will soon be restored, and that the Sepoy will soon rank with the Sivatheria and other extinct animals.

We are also indebted to the Cavaliere Meneghini for an interesting paper on the Palæontology of Tuscany. Itself the birthplace of this branch of our science, it appears that there are not wanting patient inquirers to assist Professor Sair in following up and correcting the conclusions of the distinguished Brocchi.

Mr. R. Goodwin Austen, whose researches on the chalk and underlying formations have created such interest, favoured us with a communication on the occurrence of a granite boulder in the chalk.

Dr. Kinahan, the Rev. Mr. Symons, Mr. Baily, Mr. Salter, Mr. Page, have made some valuable palæontological communications.

Palæontology is now assuming so important a position in the world of science, and so many valuable discoveries are continually rewarding the researches of our English friends, that it may not be uninstructive to enumerate some of the more remarkable results during the past year.

Professor de Mulot describes the discovery, by Messrs. Uhlmann and Jahn, of remains of the gigantic elk (*Cervus euryceros* or *megaceros*), in association with the works of human industry. They were found in 1856, near a small lake near Mooscedorf (Canton of Berne), which was being drained, in a bed of peat three or four feet thick, together with fragments of pottery, stone chisels, stone arrow-heads, pieces of cut bones, and perforated bears' teeth, without any trace of metallic objects, and also carbonized grains of barley. There were also found in the same locality many fragments of bones both of domesticated and wild animals, viz., horned cattle, horses, swine, dogs of various sizes, goats, sheep, cats, elks, stags, aurocks, bears, wild boars, foxes, beavers, tortoises, as well as several birds and other animals still undetermined. These details are interesting in order to determine the age of this animal, which appears to have evinced so remarkable a partiality for the climate of this country.

Captain Spratt, R. N., discovered in a tertiary formation at Salonica, of fresh-water origin, some fossil vertebræ of a serpent. Professor Owen considers it an extinct species, different from any of those existing at present in the south of Europe; and that it was between ten and twelve feet in length. The vertebræ offer many points of resemblance to those of the rattlesnake and viper, but there are no certain grounds for the conclusion that it was a poisonous reptile. The traditions of ancient Greece point to large serpents, and the discovery of these remains suggests the importance of attempting to trace in the superficial deposits of that country evidences of the existence of the lion or other large beasts of prey, which Hercules and the other heroes are said to have destroyed.

Professor Owen describes some bones of the *Dichobure ovina*, an anaplotheirod quadruped from the upper eocene marl of the Isle of Wight; also some remains of the *Dichodon cuspidatus*, an extinct mammal from the eocene sand of Hudwell, Hants, and also at Alum Point, in the Isle of Wight.

Dr. Falconer describes two species of Plagiaulax from Purbeck. This is a marsupial animal, and is only one among many species of extinct mammalia, the exuviæ of which have been found in the dirt-bed of Purbeck. It is to be hoped that this locality will be adequately examined and illustrated, as Mr. Beales, resident there, is a most valuable practical explorer, and a systematic discription of the remains found there by Professor Owen would be of the utmost value. To omit minor discoveries, Messrs. Wyville Thomson and Salter describe several new varieties of the Acidaspis from the Silurian strata of Ayrshire and Shropshire.

Mr. J. W. Kirkby also describes some curious Crustaceans and Chitons from the Permian strata of Durham.

I cannot conclude this part of the subject without alluding to the remarkable paper by Dr. Falconer, read before the London Geological Society, on the different species of Mastodon, particularly those found in the British strata. He draws a marked distinction between the *Mastodon angustideus* and *Mastodon arvernensis,* contrary to the views of Cuvier and Owen. The former he considers peculiar to the *miocene* strata, the latter to the *pleiocene.* He further concludes:—

1. That the *Mastodon* remains, found both in the *fluvio-marine* or *Norwich crag,* and *red crag,* belong to the *pleiocene* form, *Mastodon* (*tetralophodon*) *arvernensis.*

2. That the mammalian Fauna of the *fluvio-marine crag* bears all the character of the *pleiocene* age, and is identical with the *sub-Appennine pleiocene* Fauna of Italy.

3. That the *red* and *fluvio-marine* crags, tested by their mammalian Fauna, must be considered as beds of the same geological age.

It is very much to be desired that Dr. Carte, or some person equally well qualified, would undertake the publication of a monograph of the Irish fossil mammalian remains.

I shall now touch upon some subjects more closely connected with Irish Geology; and, in the first place, I rejoice to find that Professor Haughton is not relaxing in his inquiries as to the mineral composition of the Irish rocks.

He read to us a paper on the Siliceo-felspathic Rocks of the south of Ireland, which affords some remarkable results. These rocks are situated in the mining district of Ovoca, and county of Wicklow; in the district of Bonmahon, county of Waterford; and also in the neighbourhood of Killarney and Kenmare Bay, in the county of Kerry. They resemble much in chemical composition, though not in appearance, the *elvans* of Cornwall, and the miners consider that they have an equally favourable effect on the mineral lodes. They are, however, frequently deposited in stratified bed, conformable to the slates and felspathic ash-beds in which they are situated. Professor Haughton has analyzed with his usual care several specimens of these rocks, and the conclusions he comes to are as follows:—

			Per cent.
Bell Rock, Vale of Ovoca—		Quartz,	45·54
,,	,,	Orthoclase felspar,	54·16
			99·70

Rocks of Bonmahon, Co. Waterford—		Quartz,	40·81
,,	,,	Orthoclase felspar,	57·19
,,	,,	Carbonate of lime,	1·81
			99·81

		Per cent.
Benaunmore, county of Kerry.		
This rock is columnar trap—Quartz,	. . . .	20·51
,, ,, Orthoclase felspar,	. . . . .	77·85
		98·36

Professor Haughton mentions, in connexion with these rocks, a fact of great interest to the student of Irish antiquities and ethnology. On examining, with Mr. Wilde, the collection of stone implements in the Museum of the Royal Irish Academy, these siliceo-felspathic rocks appear to have been carefully sought out by the makers, and there are very few specimens in that large collection which cannot be identified as made of Irish rock. There are, however, some stone implements from Jamaica, formed of the same kind of stone, which, for its hardness and toughness, would appear to be peculiarly adapted for such purposes.

Mr. Du Noyer read a paper on the Junction of the Slate and Granite at Killiney.

Dr. Clarke, a paper on the Alterations of Local Level near Waterford.

Mr. Baily, a detailed account of the Fossils collected by the Geological Survey in the Carboniferous Rocks of the county of Limerick.

Mr. Wynne, on the Structure of the Galtees.

Mr. G. H. Kinahan, on the Trap of Valentia Island; and Dr. Kinahan, on the Zoological Relations of Bray Head and Howth. These were all interesting papers, particularly the latter.

There has been, as all geologists are aware, considerable discussion as to the subdivision of the Carboniferous System of Ireland. Until lately, Dr. Griffith's classification of these rocks was undisputed; but Mr. John Kelly has lately given great attention to the subject, and I am sure that you will not consider your time wasted in considering the arguments on both sides of this important question.

Mr. John Kelly, in a paper read before this Society, considers that the—

1. Old Red Sandstone,
2. Carboniferous System (Carboniferous Slate, &c.),
3. Limestone,
4. Coal series,

are all subdivisions of one great formation, in the ascending order, in which the whole series from the beginning to the end was deposited, without any great catastrophe in the succession. They are all parallel one to the other; they rest unconformably on the inferior or underlying rock, and are covered unconformably by the overlying rock; the fossil evidence also confirms this view, as the lowest member of this formation, the Old Red Sandstone, contains organic remains common in the mountain limestone.

In this formation there is not included a deposit, called by Mr. Kelly, *Brownstone*, and which has been associated with the Old Red Sandstone

or Devonian rocks of the English geologists. Mr. Kelly considers this rock to form a connecting link, if not an actual member, of the Silurian Palæozoic rocks, and to be in no way connected with the true Old Red Sandstone.

This forms one part of Mr. Kelly's maxim, and here there is not much difference of opinion.

In the next place he refers to Dr. Griffith's subdivision of the true Carboniferous rocks.

Dr. Griffith divides them as follows, in the ascending order:—

1. Yellow Sandstone.
2. Lower Limestone.
3. Calp, alternating with black shale and sandstone, and said to be at Bundoran 1700 feet in thickness.
4. Upper Limestone.

Mr. Kelly considers that there are good grounds for interpolating a series of Carboniferous Slates between the *Limestone* and *Old Red Sandstone*, which would correspond with the *Yellow Sandstone* of Dr. Griffith; but he thinks that there should be only one *Limestone*, and he utterly objects to the existence of the *Calp*.

In order to make out these propositions, he contends, on stratigraphical grounds, that the two limestones are one, separated by a succession of faults, and that the *Calp* in the neighbourhood of Bundoran is a portion of the *Old Red Sandstone*. The great mass of *Calp* described in Dr. Griffith's Geological Map as extending over the Slievebeagh mountains from Dungannon to Lisnaskea, he places in the coal-measures, as he does also the *Calp* of the counties of Dublin, Meath, Kildare, and Westmeath, and also of the south of Ireland. His arguments chiefly apply to the vicinity of Bundoran, and both he and Dr. Griffith seem to have placed the result of the issue chiefly on the result of an examination of the carboniferous rocks in that district and in the N. E. corner of Lough Erne. Mr. Kelly has traced what he considers to be the line of the *Old Red Sandstone*, and contends that throughout, where the shales and sandstones of the Calp are introduced, there is ground for supposing that they belong to that formation, and underlie the true *Carboniferous* System. The difference of level between the limestones north and south of Bundoran he ascribes to a great fault which has thrown down the northern strata to the extent of nearly 1500 feet. As a proof of this he adduces the difference between the level of the base of the Millstone Grit on Sheanhill, on the south side of Lough Erne, and the same rock at Portinode, on the north side. The actual difference of level would be about 1000 feet, and he calculates that, in consequence of the rock dipping south, there is a downfall of about 1500 feet.

The lithological character of this formation appears to vary so much in different localities, and it has been subject to so many metamorphic agencies, that on this ground it would be difficult to find any safe ground of distinction. It is to be regretted that Mr. Kelly has not made more use of fossil evidence in order to elucidate this intricate subject.

Dr. Griffith, in his reply to Mr. Kelly with respect to the great fault alluded to says:—

"No doubt there is a fault of trifling character, having a *north and south direction,* visible near the coast of Bundoran; but in this case the strata on both sides belong to the same Calp series, while its north and south direction contributes nothing towards sustaining Mr. Kelly's assumption of the great fault extending westward from Lough Erne to the sea coast near Bundoran; and the only argument he has brought forward in support of his opinion is, that the level of the Millstone Grit at Sheanhill, on the south side of Lough Erne, is 1135 feet above the sea, while the Millstone Grit on the north side of Lough Erne is only 150 feet above the sea; and, arguing on this difference of level of 985 feet, he assumes that a downthrow of about 1000 feet has taken place between the north and south shores of Lough Erne. But Mr. Kelly's basis for the argument has no foundation, because the strata on the north side of Lough Erne consist of *Yellow Sandstone* and not *Millstone Grit.*"

As I am not aware of any answer from Mr. Kelly to this statement, I presume it sets at rest this part of the question.

Dr. Griffith, in further confirmation of this theory, gives some very instructive sections:—

1. From Butler's Bridge, county of Cavan, and extending westward by Belturbet to Slieve Rushan Mountain, crossing Cuilcagh Mountain, the valley of the Shannon, Lackagh and Benbo Mountains, and terminating at the sea-shore at the western base of Benbulben Mountain. This extends for fifty miles.

In this case we have a succession of concentric circles, each surrounding the other, in an ascending order from the Lower Limestone by the Calp to the Upper Limestone.

2. Another section gives the district between Bundoran and Ballyshannon, and exhibits a similar overlapping of the Carboniferous strata round Dartree Mountain.

3. In order to disprove Mr. Kelly's views with respect to Slievebeagh mountains, Dr. Griffith exhibits a section from Lisbellaw, in the Silurian strata, across the valley of Clogher, thence over the Slievebeagh Mountains, it then crosses the Carboniferous Limestone valley of Monaghan, terminates in the Silurian strata of Scot's House, west of the town of Monaghan. This section very clearly demonstrates the relative position of the Carboniferous beds.

Professor Jukes, in his paper on the Calp of Kilkenny and Limerick, strongly confirms Dr. Griffith's views with respect to those rocks by him called *Calp*, and by Mr. Kelly ascribed to the coal-measures.

He divides the Carboniferous System of Limerick and Kilkenny into three divisions, of which *Calp* forms the central one. It is distinguished from the other two by its black colour, the others being gray; it also contains but few fossils, those that are found in it resemble in character those found in the upper and lower rocks. A section through Gowran would give the following results:—

	Feet.
Thickness of the Limestone, ...	1000
Middle or Calp Limestone, ...	100
Lower Limestone, ...	1000

Another section between Pallaskenry and Foynes would give :—

	Feet.
Upper Limestone, ...	250
Calp, ...	1400
Lower Limestone, ...	1500

Professor Jukes suggests that the great thickness of the Dublin Calp may be owing to the thinning out of the upper Limestone, and that the coal-measure shales may rest on the Calp of the central counties without the intervention of any upper Limestone.

I think there can be now very little doubt of the existence of the Calp, and although we may be compelled to differ with Mr. Kelly as to his views on this subject, we must feel obliged to him for the independent manner in which he has stated his opinions, and for having brought to the test of discussion the accuracy of one of the most important land-marks in Irish geology. We all owe a deep debt of gratitude to Dr. Griffith for his Map of Ireland, and the multifarious information which he has given us upon all subjects connected with it.

Messrs Jukes and Du Noyer contributed to the Geological Section two joint papers :—

1. On the geology of an interesting neighbour, Lambay. Although noticed some years since by Mr. Hamilton, its structure, I believe, was never before minutely and accurately described.

2. On certain rocks found between the bays of Tralee and Bantry.

This latter paper has reference to a subject brought before the Association by Dr. Griffith, and there are also two other papers, one by Mr. Wynne, on the Galtees, and another by Mr. Joseph O'Kelly on a section across Slievenamuck Mountain, which have a very close connexion with Dr. Griffith's paper.

On the sedimentary rocks of the south of Ireland, some beautiful illustrative sections were exhibited at the meeting.

It appears, in the words of Dr. Griffith, that the *Old Red Sandstone* strata, consisting of alternate beds of red and green shales, red sandstones and conglomerates extend more or less continuously in an east and west direction, through the counties of Tipperary, Limerick, and Cork. We find the *Old Red Sandstone* lying conformably below the *Lower Limestone* and *Yellow Sandstone* of the Carboniferous System, and resting on the upturned edges of the Silurian rocks in an unconformable position, till, reaching the Old Red strata in the county of Kerry, they are found preserving the same relative position to the brownish-red grits, and the red, green, and purple clay-slates of the Dingle district which conform to and overlie the fossiliferous Silurian rocks of Ferriter's Cove; these being again overlaid unconformably on the western shore at Sybil Head by the beds of the Old Red series.

Dr. Griffith considers that these Old Red Sandstone beds should be associated with the *Carboniferous* System, to which they are conformable, rather than the *Devonian* System, which can hardly be said to have been yet found in Ireland. In this view all the working geologists of Ireland seem to agree.

There is, however, very great difficulty in determining the age of the grits and slates on which these rocks rest in the Dingle district. They are conformable to strata at Ferriter's Cove, which have been proved distinctly to be Upper Silurian from the fossils contained in them, but they resemble in appearance and composition the grits found to the south of Castlemaine Harbour, and which have been called by Professor Jukes, the *Glengariff Grits;* and these grits are quite conformable to the shales of the Old Red Sandstone and the beds of the Carboniferous System which overlie them. This is a difficulty which as yet has received no solution, and presents one of the greatest puzzles in all local geology; and, notwithstanding all that has been said and written on this subject, I cannot conclude better than by recommending our enterprising and earnest young friends to hasten with the fine season to the south of Ireland, and to work at these mountains until their history is clearly unravelled and explained.

ON A FOSSIL ELEPHANT'S TOOTH OBTAINED FROM THE EXCAVATION OF THE DOAB CANAL, IN UPPER INDIA. BY ALEX. CARTE, M.A., M.B., M.R.I.A.

In the November Number of the "Journal of the Geological Society of London," Dr. Falconer, who is, perhaps, the highest authority we have on Indian Palæontology, remarks in the introduction to his paper "On the species of Mastodon and Elephant occurring in the fossil state in Great Britain,"—that "it is of the highest importance to Geology that every mammal found in the fossil state should be defined, as regards, first, its specific distinctness; and second, its range of existence, geographically and in time, with as much exactitude as the available materials and the state of our knowledge at the time will admit. Every form well ascertained becomes a powerful exponent (i. e. to the geologist), while, ill determined, it is a fertile source of error." And again:—"There is a subordination in the value of the (palæontological) evidence: the higher the form in the scale of organization, the more weighty is the import of its indication." In the conclusion of his paper Dr. Falconer observes that "the Mollusca have unquestionably been wielded as a most powerful exponent of geological chronology, and of the successive physical changes which have taken place on the surface of the earth. But it will hardly be denied that the evidence presented by mammalian remains, when obtained in sufficient variety and abundance, is of greater significance as a test of contemporaneous formations in geology, or the reverse." The importance, as will be seen from these quotations, that Dr. Falconer attaches to the evidence afforded by mammalian remains, involving, as a matter of course, investigations in comparative anatomy, has mainly influenced me to enter upon the identification of a specimen

of a fossil tooth, for which the Society is indebted for its exhibition this evening to the kindness of my friend, Mr. Tufnell, who, in a letter to the Rev. Professor Haughton, has given the following particulars:—"I procured the fossil tooth at Kurnaul (among many other remains of deer and different animals), which is situated in Upper India, at about seventy miles from the foot of the Himalayas, and those fossils were obtained in an excavation which Sir Proby Cautley had made through that district, of which it is the most important public work, being well known as the Doab Canal."

Before entering upon the identification of the specimen, it may be advisable to observe that, according to Dr. Falconer, Mastodon and Elephas are Proboscidean genera, so closely allied, as to require for the determination of their several species scarcely any reference to the general character of their comparative osteology, the method of diagnosis which he adopts being solely dependent upon the distinctive characters which the teeth and jaws present. I may further allude to Dr. Falconer's method of subdividing the before-mentioned genera, to the latter of which he attributes three subgenera; namely, first *Stegodon*, comprising the species *Cliftii, bombifrons, Ganesa* (?), and *insignis*. It is through this subgenus, by its species Cliftii as a link, that Dr. Falconer thinks the genus Elephas remerges into the genus Mastodon. To the second subgenus, *Loxodon*, of which the African Elephant is the living type, the species *planifrons, meridionalis, priscus*, and *Africanus* are allotted; while the third subgenus, termed *Euelephas*, comprises the living Asiatic or true Elephant, the species *Hysudricus, antiquus, Namadicus, Columbi, Indicus, Armeniacus*, and *primigenius*.

It is to the subgenus Loxodon I would refer the specimen under conderation, and I have little hesitation in identifying it as belonging to the species *planifrons*. The longitudinal axial clefts interruptedly dividing the plates of enamel, their number and circular dilatation in the middle, with their proportional vertical elongation and cuneiform shape, as also the relations existing between the three dental constituents, with the moderate crenulation of the enamelled edges of the plates, indicate, I should say with certainty, the species to which I have referred. Though it is a point of comparatively minor importance, it were to be wished that the definition of the infradental foramina had been less obscure, and had the symphysis which connects this portion of inferior maxillary bone with the left ramus been attached, I should have been better pleased. I may also mention, as an additional means of identification, that the fossa between the coronary and alveolar apophyses corresponds in width to that of the *Loxodon planifrons*, as represented in Cautley and Falconer's beautiful illustrations ("Fauna Antiqua Sivalensis:" London, 1846).

The importance of identification of such specimens as that before us will appear, whether we regard the comparative neglect into which the subject has fallen, or the poverty, I regret to say, of our public collections in this city with respect to remains of this class, not only fossil, but recent; and though I feel that I am unable to direct your attention to

anything having the charm of originality, I cannot yet suppose that my endeavours are wholly useless or without interest; in fact, I think every accurate determination, no matter how humble its character, is of scientific value. In point of interest it will be remembered that in the *Loxodon planifrons* we have a starting-point, from which the extremes of a scale of organization radiate, and, as it were, affords a stepping-stone or passage which conducts us directly from the regions of life into the chambers of the ancient dead: on the one hand, namely, from the African Elephant to the *Stegodon insignis*, which, as already mentioned, by the *Steg. Cliftii*, passes into Mastodon proper; and, on the other, through the extinct *Euelephas Hysudricus*, into the Asiatic Elephant and fossil Mammoth.

It is scarcely necessary to remark, that the chief feature by which we are conducted on either side is the comparative elongation or depression of the conical or cuneiform segments of Loxodon into the pyramidical plates of Stegodon as we descend, and into those which display the pectinated or deeply lobed forms of Euelephas in the ascending scale. It is out of place to enter into such details as the numerical increase or diminution, as well as thinness of the ridges in the several graduating species, with other particulars less important as unsuitable to the present purpose, the mere mention of them being sufficient to indicate the extensive nature of the entire subject.

In conclusion, I have only to suggest that it may not be impossible that some such law as is observable in the succession of the Proboscidean organization may ultimately apply in completing the great structural sequence, not only of Mollusca, but of vegetable life, as we find that living Mammalia are frequently intercalated as gradational links between extinct fossil species, as in the case before us of the interposition of the African Elephant between the extinct forms of *planifrons* and *Hysudricus*, or that of the Indian Elephant passing upwards and downwards by *Namadicus* into *Hysudricus*, and again into the extreme of the series *Elephas primigenius*.

The geographical distribution of these fossils will form another subject worthy the attention of future inquirers, and, however invaluable the systematic geological arrangements to which we are at present so much indebted for the regularity and harmony which we experience in our pursuits, it is yet not improbable, and is even to be expected, that as Palæontology, especially that of mammalian remains, advances, modifications will take place as regards our ideas of geological epochs, which will not have the effect of rendering us less grateful for subdivisions of formations by which we have hitherto profited, notwithstanding that they may have been, from the very nature of the case, introduced for scientific precision.

DUBLIN NATURAL HISTORY SOCIETY.

SESSION 1857–58.

FRIDAY EVENING, JANUARY 8, 1858.

Professor W. H. Harvey, M.D., M.R.I.A., F.L.S., President, in the Chair.

The Minutes of the previous Meeting having been read and confirmed—

Mr. R. P. Williams apologised for the unavoidable absence of Mr. Andrews, owing to which Lord Clermont's communication, relative to the Mute Swan, was postponed. He had to present, on behalf of Lord Clermont, a specimen of the mute swan (*C. olor*), captured under circumstances which left little doubt of its being a truly wild specimen (*vide* "Proceedings" for February, 1858, *postea*).

A special vote of thanks was passed to Lord Clermont for his donation.

Mr J. B. Doyle submitted to the Society a communication he had received from his friend, Robert Evatt, Esq., Mount Louise, an observant naturalist, in reference to the habits of the mute swan, whether it was known that the male bird assisted and relieved the female bird on the nest during the season of hatching? He had observed the male swan preparing the nest, and sitting on it, previous to the eggs being laid by the female; but, although he had for some time been watching, he never could detect the male swan in the act of incubation, until one evening, rowing over to the island, he found him actually on the nest, the female not being in sight—the bird was sitting, at the time, on six eggs. Although he had been endeavouring for twenty years to breed swans, he had never succeeded until lately—the eggs never maturing—until he constructed a kind of hut with poles and fir branches over the nest, and with this protection he succeeded in rearing young birds. Thunder or very stormy weather was apt to destroy the young birds in the eggs unless shelter was formed over the nest. Mr. Doyle wished for information on these points from the experience of any of the members.

Mr. Robert John Montgomery observed that the habits of the mute swan had long been familiar to him, and that he had constantly seen the male bird on the nest hatching. He was surprised to hear that any difficulty had been experienced in hatching the eggs. He always found them extremely prolific, and managed with very little care.

Mr. R. P. Williams confirmed the fact of the male swan generally assisting the female in her duties.

Rev. E. O'Meara exhibited some most interesting specimens of organic remains from the Cambrian rocks of Bray Head, consisting of diatomaceous frustules and spicules resembling those of sponges. The specimen of rock operated on was given him by Dr. Carte, and seemed to consist of a mass of Oldhamia, regularly matted together. He experienced much difficulty in operating on it, owing to the great quantity of amorphous silica present, which it was impossible thoroughly to remove. Every slide of the deposit he examined contained specimens of diatoms as well as the spicules.

Professor Kinahan thought it might be interesting to the Meeting to know the exact locality of the specimen acted on. It was from the mass of green beds described by him in the Journal of the Geological Society of Dublin some time since, and were composed, as the Rev. Mr. O'Meara had stated, of a matted mass of *Old. radiata,* which had evidently been floated into some quiet nook of the Cambrian sea, and settled down there, the zoophytes bearing on their stems diatomaceous forms exactly as we find their allies, the sertularian zoophytes of our own seas, loaded with living forms of Diatomaceæ. Mr. O'Meara's discovery was one of great importance, as everything which tended to throw light on the nature of these ancient deposits was of great value to the geologist, and it being found that at the present day diatoms of different and often distant localities are identical, we may be, perhaps, able, by an examination of similar deposits in Wales, to obtain another link in the chain of evidence as to their identity or not with Irish Cambrians.

Mr. Robert John Montgomery read the following—

ON PECULIARITIES IN THE HABITS OF THE STARLING (STURNUS VULGARIS).

Many members present have, I dare say, witnessed the very remarkable gathering of starlings (*Sturnus vulgaris*), for the purpose of roosting, during the winter months, in the Gardens of the Royal Zoological Society in the Phœnix Park, and to which the late Dr. Ball first directed attention, through the means of the public press, in March, 1845, estimating their numbers at from 150,000 to 200,000.

Although the great starling roost which I had the gratification of visiting in the county of Donegal, in the commencement of this winter, was far, far inferior, in point of numbers, to that in the Phœnix Park, yet I thought it of sufficient interest to make a note of at the time, and that note I now have the pleasure of submitting to the Society.

I went to Lough Fern, a beautifully situated sheet of water, of about three miles in length, on the 19th of November last, with a friend, an ardent lover of ornithology, the Rev. Robert Harvey. Our principal object in going was, to ascertain how many species of Anatidæ frequented the lake. At the western end of the lough there are immense beds of reeds (*Arundo phragmitis*), standing many feet in height out of the water. Near to the inner edge of these I took my position to have a shot at the evening flight of ducks.

Shortly before dusk we remarked small parties of starlings begin to arrive. These circled about over the reeds, every few moments receiving considerable accessions to their numbers. Presently, larger bodies made their appearance, and, joining their comrades, formed one immense flock. This flock then split into two companies, one circling over the reeds on the northern side, and the other, apparently endeavouring to rival their friends in the beauty of their aerial evolutions, on the southern side; sometimes rising to a considerable height, and forming the most beautiful figures against the clear evening sky; then again making a downward rush, until the *sough* of their wings resembled the roar of a mountain torrent, they would disappear amongst the reeds; for a moment all would be still—no sound to be heard but the mournful sigh of the wind through the tall reeds, the whistle of the widgeon (*Anas penelope*) far out on the lough, or the call of the partridge in the adjoining fields; when suddenly a strange guttural chatter would strike upon the ear, overcoming every other sound. This would continue a few moments only, and then, with a noise like a tempest, would the mighty flock arise once more.

These evolutions continued until it was pretty dark, when the immense multitude finally settled among the reeds. The estimate I made of their numbers, at the time, was 18,000 or 20,000; but since then I have come to the conclusion that they far exceeded that amount.

In reply to inquiries I have since made, I find that they have resorted there for a great many years; that they have latterly, especially this winter, greatly increased; they commence coming there for the purpose of roosting about November, and disappear by degrees in spring. I observed in several parts of the country, though many miles from Lough Fern, parties of starlings, towards evening, all flying in the direction of the lough, and my friend, Mr. Harvey, tells me he has observed them in the morning flying apparently from it.

What surprises me is the fact of their continuing to frequent the same place for so many years, as I have, in every other instance which has come under my own observation, found the starlings very capricious with regard to their roosting-place. I have known several instances in Donegal and other counties of their frequenting a place for some years, and then totally deserting it, apparently without cause. Thompson mentions some similar cases. I remember in the county of Louth, during the intense frost in the winter of 1855, I observed on several occasions immense flocks of starlings towards evening, all flying in the same direction; they amounted to many thousands, and were evidently a migration into that part of the country. I watched them with very great interest, and found that during the severe frost they nightly congregated in a place called Ballydonnell, where they roosted among evergreens and small trees. Why they selected that place I am at a loss to know; it is only half a mile from the extensive old woods and plantation of Beaulieu, which they actually passed. I never saw them in great numbers there before that winter, nor have I seen them since.

Mr. J. B. Doyle observed that two instances illustrative of peculiarities in the habits of the starling had come under his notice. When in Wicklow some years since, shooting, in the latter end of August, between Wicklow and Seapark, in a cover adjacent to the sea, his attention was attracted by an unusual noise and chattering, which, on emerging on the strand, he found to proceed from an enormous multitude of starlings congregated in the trees, evidently having just arrived in migration; it appeared, however, that this was an unusually early migration of these birds. The other instance had reference to the fact that the starlings do not confine themselves to the one kind of roosting ground. At Dunran, county of Wicklow, they roost in old ruins. In 1839, after the great storm, at Mr. Templeton's, Waterton Demesne, he saw numbers of them dead and wounded among the trees, killed by the clashing of the boughs against one another. On inquiry he found that the beech trees there were their usual roosting-place.

The Chairman then declared the following duly elected:—

Ordinary Members:—Joseph Reay Greene, Professor, Queen's College, Cork; George Dixon, Esq., Dublin; William Hodges, Esq., Rathgar.

Corresponding Member:—The Rev. Robert Harvey, Leck Glebe, Letterkenny.

The Society then adjourned till the 5th of February.

FRIDAY EVENING, FEBRUARY 5, 1858.

Professor W. H. Harvey, M.D., M.R.I.A., F.L.S., President, in the Chair.

Mr. William Andrews, Honorary Secretary, read the following—

NOTES ON THE CAPTURE OF A MUTE SWAN (CYGNUS OLOR) IN DUNDALK BAY. BY LORD CLERMONT.

The mute swan, which I have the pleasure of presenting to the Dublin Natural History Society, is interesting from having been taken under circumstances which favour the supposition that these birds occasionally visit our shores in a truly wild state. It was shot on the 27th of February, 1857, in Dundalk Bay, about a mile from the land, out of a flock of six, by a fisherman in my employment, who observed the swans flying over the sea, and alighting on it. He then put off in a boat, and succeeded in getting within shot of the flock. All the birds had, he said, some brown plumage.

The fact of these birds being strong on the wing, and coming in from seaward, does not look like birds reared on a lake or river. There have been flocks seen in Belfast and Strangford Loughs each winter now

for three successive years, several individuals of which have been approached and shot like common wild swans; and as several instances of the occurrence of the mute swan wild in France and Belgium are given by De Selys Longchamps, and Degland, Yarrell, too, admitting that they occur wild in nearly every country of Europe,—I see no difficulty in concluding that this species, like the two others, is at times impelled by the severity of a northern winter to seek a milder climate on the more temperate shores of the British islands. Nothing is more probable at all events; and although their wandering habits when half tame justify suspicion and inquiry into the particulars of each case, there does not seem to be any reason, when these favour the wild theory, why it should not be accepted where there is so little difficulty in doing so. However, not being a very experienced ornithologist, I submit my views subject to correction.

Mr. Andrews said that this specimen, so kindly presented to the Society, could not, under the circumstances given by Lord Clermont, be otherwise received than as truly wild,—no records of the capture of the mute swan (*Cygnus olor*), in the British islands admittedly wild, have been given, but there was not any possibility of considering this as anything but a visitor in a wild state. It appeared to be a bird of the first year; and although from its large proportions it might bear some affinity to the Polish swan, yet there were sufficient characteristics to separate it from *Cygnus immutabilis*, and to identify it as a yearling of *C. olor*.

Rev. Professor Haughton exhibited some specimens of plant stems, found in the micaceous yellow sandstone beds of Herrylock, county of Wexford, on the east shore of Waterford Harbour. (Figures and descriptions of these will be given *postea.*)

The President observed that the stem of the grass tree of New Holland (*X. hastilis*) exhibited just such a section as that described, the cross lines being formed by the bases of the old leaves, and the mid-axis by the stem of the plant. He had also seen specimens of parasitic plants, such as ivy, which might explain the other specimens exhibited, in which the twining plant had become imbedded in the bark of its support.

Dr. J. R. Kinahan next read a paper, as follows:—

ON THE SUBAQUEOUS HABITS OF THE WATER OUZEL (CINCLUS AQUATICUS).

During the years 1849 and 1850, having nearly daily occasion to frequent that part of the river Dodder which passes through the romantic mountain glens of Glenismaul and Castlekelly, the great abundance of the water ouzel, or, as the peasantry there call it, kingfisher, induced me to study its habits somewhat particularly. The results of this investigation were brought by me before the Dublin Philosophical Society at its opening meeting in the latter year. That communication never having been printed, I purpose to lay before this Society to-night the more important conclusions to which I was then led, the accuracy of which a frequent

study of the bird in the counties of Wicklow, Waterford, Galway, Tipperary, Clare, and Tyrone, have but confirmed me in, and which also, as far as I can learn, have never been fully recorded by any of our authorities.

The general habits of the water ouzel have been so well and so often described that they need not detain us; but although it is now some years since M. Herbert announced the fact that this bird is possessed of the power of walking under water on the bottom of streams; and although the truth of this observation has been strengthened by the evidence of such men as St. John, Dilwyn, Rennie, William Thompson, and M'Gillivray, yet still there are found many (especially among the closet naturalists) who prefer to ignore the fact altogether, or else assert that this bird's habits in this respect are identical with those of other divers.

My observations, made repeatedly during many months, and having for their object the elucidation of this very point, enable me to corroborate M. Herbert's account in every particular, except that the bird carries down a supply of air to the bottom enclosed within its wings, in which he most certainly is in error, led away by a fancied analogy between the bird and diving beetles, as I have repeatedly seen them rise to the surface to obtain air, which they do exactly like a grebe, merely raising the tip of the bill out of the water.

The bird has several modes of diving. When seeking food it generally goes down, like most divers, head foremost in an oblique direction, or else walks deliberately in from the shallow edge of the pool, the head bent down, and the knees (tarsal articulation) crouched. When seeking refuge, however, it sometimes sinks like a stone, exactly as the great northern diver (*C. glacialis*) has been observed to do—that is, gradually, the top of head the last part submerged, without any apparent exertion, sometimes in the midst of its most rapid flight dropping down suddenly into the water like a plummet. Its course is indifferently with or across the stream, rarely against it.

It often remains under water totally submerged for fifty seconds and upwards, and during that time will proceed from ten to twenty yards. When it comes out, the water may be seen running rapidly off its plumage. It swims with great rapidity, and appears to rejoice in the water as its true element, hardly ever alighting directly on a rock, but even after its longest flight splashing slap into the water, at the base of the stone selected as a resting-place, and then scrambling to the summit of this. In its motion in the water it more closely resembles the jackass penguin of Cape Horn (*Apt. chrysocoma*) than any other aquatic bird I have had an opportunity of studying. Like that bird (especially in the breeding season), the ouzels may be seen at times leaping right out of the water in their gambols.

That the bird actually does possess the power of motion under water, the following notes on a wounded bird, made on the spot, abundantly prove:—

"Nov. 29, 1850.—Bohernabreena. Wounded a water ouzel which, as I observed them all to do, immediately made for shore. On my going

to seize him, he darted into the water, running slap in; waded in after him; under water he looks quite glossy, but does not seem increased in bulk, the glossiness probably arising from the oiled state of the plumage, or else from its peculiar texture. When I first got up with the bird he was perfectly stationary at the bottom, not using any exertion to remain there (this remark applies to two other birds wounded later in the day, which also took to the water). The bird next got under a big stone, and when I poked him out on one side he ran to the other—after the lapse of a minute or so he put his head out of the water to breathe, always keeping the stone between him and me, and when I tried to catch him he would dodge under the water again, and come up on the other side.

"Finding that I was still chasing him, he took to the stream, and went under water faster than I could follow him; he seemed to move now altogether by means of his feet, his wings hanging down behind his tail, though his motions were so quick it was difficult to be positive as to the latter part of this observation. At times he swam in mid-water, using his wings, crossing the current several times, and seeming but little incommoded by it.

"All at once he turned over on his back—still possessing the power of continuing under water—struggling to regain his original position, he spun round and round; it appeared as though the wounded wing had suddenly failed him, and thus prevented his preserving a due equilibrium in the water. At length he came to the top, when he immediately righted and swam as at other times; every time I tried to lay hold on him he again ducked and dived down to the bottom, at first all right, and then the tumbling began again. When captured at length, I found him merely winged."

I was enabled to confirm these observations several times that day, as I obtained seven specimens, five of which necessitated a watery chase before I succeeded in catching them, and one got clear off. I ought to explain such seeming needless cruelty in shooting so many of these harmless birds, but the specimens were required for a series of dissections at that time in hands.

From these observations it would appear that both feet and wings are used in progression, the latter in mid-stream (when the bird almost looked as if it were flying), the wings doubtless being also of essential use in preserving a proper balance in the water, probably acting like the pectoral fins of the fish. The bird's progression along the bottom was certainly by means of its feet alone.

Like many water animals, the sensation in this bird appears blunted; at least, two of those I winged and afterwards captured sat coolly looking at me, as though uninjured, without leaving their position, perking and jerking their tails, and "checking" at me as unconcernedly as possible, so that, had I not had some confidence in my aim, I should certainly have taken a second shot at them. The stomachs of all those I examined contained only insect remains.

This bird is extremely common in our mountain glens. I have

counted as many as ten broods in Saggart Slade, and, although called an unsocial bird, it is to be always found in pairs. These certainly keep apart, but many pairs will be met in favourable localities in a very limited area. They keep nearly altogether to the glens. I saw the bird but once below Rathfarnham Bridge in the Dodder. This was at Dartry, at the circular weir. Surely, the fearlessness and curious manner of this bird, the harmlessness of its habits, the adaptive power displayed—in the elongated valve-like opening of the nostrils, the absence of gape-bristles, the partial webs to its feet, the dense peculiar nature of the plumage, and the general dissimilarity between it and the other thrushes, form a groud of characters which, taken in combination with the wild and romantic nature of the scenes it mostly loves to frequent, ought to render this bird as great a favourite with the field student as it generally is with the fisher, plying his lonely task amidst its secluded haunts, and hailing as an old acquaintance the tidy little white-breasted water blackbird, as it sits jerking and posturing on a rock amidst the boiling waters, swimming on the eddying current, diving beneath the depths, chattering to its mate, or enlivening the mountain glen with a simple but plaintive strain to the fitting and appropriate accompaniment of the ceaseless bubble of the sparkling waters of the gushing mountain rill.

The Honorary Secretary read a communication as follows :—

DESCRIPTION OF A STARLING ROOST AT RATHKEALE, COUNTY OF LIMERICK. BY G. HENRY KINAHAN, C.E. T. C. D., CORRESPONDING MEMBER, G. S. I.

The following brief account of a starling roost at Rathkeale may be of some interest to the Society, as a pendant to Mr. R. J. Montgomery's paper, read at your last meeting.

To the north-east of Rathkeale village, county of Limerick, there are two lakes, the larger of which is called "Doohyle Lough ;" at the east side of this there is a marsh running E.N.E., and W.N.W. Last winter, my work lying that way, I had occasion to pass it frequently.

Coming home late one evening after dark, I was surprised, whilst walking along the road to the north of the lough, to hear a tremendous chattering, which would sometimes suddenly cease, and one heard a long continuous whirr, like that of a strong rushing wind. It was then too dark to see anything, and although I knew they must be birds, yet their kind I could not say. I could hear the whirr, caused by the flocks getting up, nearly the whole way into Rathkeale (over a mile). The next day, on returning the same way, the noise of the preceding night was fully explained by my seeing innumerable starlings congregated about the lake.

Some evenings afterwards I went on purpose to watch the birds; I arrived at the spot about half an hour before sunset, and immediately afterwards the stares began to arrive in flocks of three and four hundred. The first flock flew round the lake, and then lit in a field to the south; a few minutes more, and another flock arrived, which, after

flying round the lake, joined the first comers; these immediately rose, and all took a circuit round the fields, and then alighted again.

Flocks now came in thickly from all sides, the same performance being gone through at each arrival, until the flocks began to come so fast that they had no time to remain on the ground at all. The main flock then adjourned to the lake; arriving there, it took two or three circuits of the lake, and then alighted among the reeds; the arrivals now were not so numerous as they had been, but many flocks still came in, and each arrival was the signal for a general move and promenade as before. This procedure was kept up till about half an hour after dark, and then ceased, so that I presumed all had arrived in that time (two and half hours). When I left, a constant chattering and gossip was going on among the reeds.

I could form no accurate estimate of the numbers that were there, but the reeds on the north of the lake are about a quarter of a mile long, and two hundred yards wide, and every reed seemed to have a half a dozen on it. I could always tell, ever afterwards, when it was getting late by seeing the starlings going Doohylewards.

With regard to the breeding-place of starlings—in the Court-house square, Rathkeale, at the rere of one of the dwellings, there is an old pigeon-house, in which a lot of starlings build; and the owner of the house says that they remain there summer and winter. I saw them there in the spring, I suppose over forty of them, just as tame as pigeons about the yard and house.

[Since my last communication I find that the stares have left Doohyle, chiefly, I think, on account of the shooting parties (nearly every evening there after dusk) this winter. When I found Doohyle was deserted, my curiosity was aroused to discover their present abiding place. I, therefore, watched the flights every evening, and found that they were in a direction to the west of Newcastle. Knowing the country well thereabouts, I thought it might be in one of the planted glens in Coal-measure Hill, no lakes being in that quarter; and on coming home that way the other evening, I found, as I had expected, the stares assembling in a young fir plantation, in a deep ravine due west of Newcastle, and about one mile to the north of Barnagh Hill. On the road from Newcastle to Abbeyfeale I have observed the birds going to their roost; from Abbeyfeale, ten miles to the west; from Shanagolden, eight miles to the north; and from Rathkeale, eleven miles to the east. The flights occur about sundown.—G. H. K., Rathkeale, Feb. 24, 1858.]

Dr. Kinahan thought the communication just read most interesting. It would be advisable if observations were to be made in all the different parts of the country which these birds frequented, as to whether, as had been stated by Mr. R. J. Montgomery in his paper on the last evening, starlings returned to the same roosting-place each year. There were many points of interest connected with the habits of partial migrants—that is, such birds which, as the wild duck, snipe, starling, &c., were resident in small numbers in this country throughout the year, but received a great accession to their numbers in the winter

months; and perhaps not the least interesting would be to ascertain whether they, like the gregarious summer visitants, return to their old localities or not.

Mr. Grubb exhibited a microscope of his own construction, which combined a steady stage, the power of placing the tube in either a vertical or horizontal position, and of applying every kind of illumination seriatim, without taking the eye off the object. He entered fully into the history of the improvements introduced in illuminators as regarded illumination, and the azimuth as regards the object, explaining the nature of Shadbolt's illuminator, as modified by Mr. F. Bergin, the objections to the method, and his own improvement of a mirror revolving on an arc.

Mr. Grubb explained and exhibited to the Meeting a series of beautiful manipulations illustrative of the improvements in the microscope he had made.

After the ballot, the Chairman declared Henry P. Heney, Esq., duly elected Ordinary Member.

The Meeting adjourned to the first Friday in March.

ROYAL IRISH ACADEMY.

MONDAY, JANUARY 11, 1858.

Humphrey Lloyd, D.D., Vice-President, in the Chair.

Alexander T. Blakeley, Esq.; Maurice Henry Collis, M.B.; Howard B. Montgomery, M.D.; and John Purser, Jun., Esq.; were elected Members of the Academy.

The Rev. Dr. Lloyd read a paper—

ON THE DETERMINATION OF THE INTENSITY OF THE EARTH'S MAGNETIC FORCE IN ABSOLUTE MEASURE, BY MEANS OF THE DIP CIRCLE.

The received method of determining the intensity of the earth's magnetic force is unsuited to the high magnetic latitudes, the error of the deduced force, arising from a given error of inclination, becoming very considerable when the latter approaches to 90°. To remedy this defect the author suggested, some years since,* another process, in which the total intensity is found *directly* by means of the dip circle,—the *product* of the earth's magnetic force into the magnetic moment of the magnet being determined by the position of equilibrium of the dipping-needle, when loaded with a small weight, and the *ratio* of the same quantities being found by removing the needle, and employing it to

* See "Proceedings," January 24, 1848.

deflect another substituted in its place. Subsequent considerations, however, led him to propose that the dip-circle should be employed only in the *latter* part of the process, and that the observation should be completed by the known method.

In the present communication the author shows in what manner this complication may be avoided, and the original proposal carried out. It is of great importance to the scientific traveller that the instruments which he has to carry should be reduced, as far as possible, in number and weight, and that their adjustments should be few and simple; and these objects, it is believed, will be attained by the use of the method now proposed.

The equation of equilibrium of a dipping-needle, when loaded with a small weight acting in opposition to magnetism, is

$$M(Y\cos\eta - X\cos a\sin\eta) = Wr; \qquad (1)$$

in which X and Y denote the horizontal and vertical components of the earth's magnetic force, M the magnetic moment of the needle, a the magnetic azimuth of the plane in which it moves, η its inclination to the horizon, W the added weight, and r the radius of the pulley by which it acts. And when this needle is removed, and applied to deflect another substituted in its place, the equation of equilibrium of the latter is

$$Y\cos\eta' - X\cos a'\sin\eta' = MU; \qquad (2)$$

a' and η' denoting, as before, the azimuth and inclination of the needle, and U being a function of the distance of the centres of the two needles, and of certain integrals depending on the distribution of free magnetism in them.

When the planes in which the needles move coincide with the magnetic meridian, or $a = 0$, $a' = 0$, the left-hand members of these equations are reduced respectively to $MR\sin(\theta - \eta)$, $R\sin(\theta - \eta')$; R denoting the total force, and θ the inclination. Wherefore, multiplying, we have

$$R^2\sin(\theta - \eta)\sin(\theta - \eta') = UWr; \qquad (3)$$

an equation which gives the force, R, in terms of the observed angles, θ, η, and η', and of the quantities U, W, and r.

But the angles, θ, η, and η', are liable to error, arising from the friction of the needles on their supports; and the corresponding error of the deduced force varies inversely as the sine of the angle of deflection, $\theta - \eta$, or $\theta - \eta'$. It is, therefore, requisite for accuracy that these angles should be considerable. There is no difficulty in augmenting the angle of deflection as much as we please in the first part of the process, in which the deflection is produced by a weight. But in the second the case is different; and, with the slender needles here employed, a large deflection can only be attained by placing the deflecting needle at a very short distance from the moveable one. The most convenient arrangement appears to be to attach the former to the moveable arm of the divided circle which carries the verniers, and at right angles

to the wires of the microscopes: so attached, it must always be rendered perpendicular to the deflected needle in the course of the observation, although in a different plane.

The quantity denoted by U, in this position, is a function of the distance of the centres of the two needles, and of the ratios of certain integrals which depend upon their magnetic distribution. It may be shown that the variations of these ratios, arising from the gradual changes of magnetism of the needles, may be disregarded; so that, if the distance be invariable, the function U will be constant. This is a point of considerable importance; for it follows from it that, even if the value of U be unknown, R will be relatively determined by a process which is *independent of the changes in the magnetic moments of the two needles.* Hence, if the value of the force be found at any one place, by any independent means, it will be absolutely known at all.

But the value of the constant U may be found by deflection, by the instrument itself, and the method therefore rendered rigorously *absolute.* In using the dip-circle for this purpose, it will be convenient to produce the equilibrium by turning the instrument in azimuth until the deflected needle is vertical; for, in this case, the deflecting magnet is always horizontal, and can be placed in the usual position with respect to the deflected magnet, without difficulty. For this purpose the apparatus is provided with a gun-metal bar, having a rectangular aperture, by means of which it passes over the box containing the deflected magnet, and rests on two supports fixed outside on the level of the agate planes. The deflecting magnet is to be placed on this support, at different known distances, and on each side of the deflected magnet, its axis being in the plane in which the latter moves; and the apparatus is to be turned in azimuth until the deflected needle is vertical. In this case equation (2) becomes

$$- X \cos a = MV;$$

in which V is of the form

$$V = \frac{2}{D^3}\left(1 + \frac{p}{D^2} + \frac{q}{D^4} + \&c.\right).$$

The quantities p and q are to be found in the usual manner, by repeating the observation at several known distances, and eliminating among the resulting equations. This being done, the deflecting magnet is to be removed from the bar, and placed in its ordinary position between the microscopes; and the observation is to be repeated. If α_0 denote the corresponding azimuth,

$$- X \cos a_0 = MU;$$

whence

$$U = V \frac{\cos a_0}{\cos a}.$$

The method here proposed appears to offer the following advantages to the travelling observer :—

1. It is applicable, with equal accuracy, at all parts of the globe.

2. It dispenses with the employment of a separate instrument for the determination of the magnetic intensity, and with the separate adjustments required in erecting it.

3. The constants to be determined—the magnitude of the added weight, and the radius of the pulley by which it acts—can be ascertained with more ease and certainty than those which are required in the method of vibrations, and are less liable to subsequent change.

4. The observations themselves are less varied in character than the usual ones, and may be completed in a shorter time.

The Rev. Dr. Lloyd also read a paper—

ON AN IMPROVED FORM OF THE THEODOLITE MAGNETOMETER.

Dr. Lloyd exhibited to the Academy an improved form of the Theodolite Magnetometer, constructed under his direction by Mr. Jones of London, for the Magnetic Survey of the British Islands now in progress.

The principle of the improvement consists in observing the celestial object, whose azimuth is known, *by reflexion*, and in transferring the necessary adjustments to the small mirror used for that purpose. A light gun-metal frame, 13 inches long, and 3 inches wide, is attached to the upper plate of the theodolite. Near one end of this frame are two Y supports, placed longitudinally, to receive the observing telescope; and near the other are two similar supports, placed transversely, to receive the cylindrical axle to which the mirror is attached. The magnetometer box is placed between, over the centre of the divided circle. The telescope, accordingly, remains *horizontal*, and is always in adjustment for the observation of the collimator magnet; and the image of the celestial object is brought to the cross of wires in its focus, by turning the apparatus in azimuth, and, at the same time, causing the mirror to revolve. The axle is furnished with a slow motion for the purpose.

There are three adjustments required:—

1. The axle to which the mirror is attached must be horizontal when the instrument is levelled. This is tested by a small riding-level. It may be effected permanently, with sufficient exactness, by filing one of the Y's.

2. The *mirror* must be parallel to the axis of the cylindrical axle to which it is attached. This is tested by reversing the axle in its Y's, and by noting the reflected division of a scale cut by the wire in the focus of the telescope, before and after reversal. The adjustment is effected by means of three screws at the back of the mirror.

3. The line of collimation of the telescope must be perpendicular to the axis. This may be tested by observing a well-defined distant object in the horizon, first by reflexion, and afterwards directly; the deviation of the line of collimation from the normal to the mirror is half the supplement of the angle through which the telescope is moved. The adjustment may be most readily made by moving the wire-plate in the focus of the telescope.

Sir William R. Hamilton read a paper "On some General Theorems in the Calculus of Definite Integrals."

MONDAY, JANUARY 25, 1858.

James H. Todd, D.D., President, in the Chair.

The Rev. William Reeves, D.D., read a paper "On the Cathach of Columcille" (deposited in the Museum of the Academy by Sir Richard O'Donnell, Bart.)

John Kells Ingram, LL.D., read a paper—

ON THE OPUS MAJUS OF ROGER BACON.

After some introductory observations on the unjust neglect with which the writings of Roger Bacon have hitherto been treated, the author proceeded as follows:—

In the course of my studies I have been able to clear up one unsettled question respecting the works of this eminent man; and I have thought it probable that the Academy would be interested by any contribution, however small, towards our knowledge of a subject so imperfectly understood.

The "Opus Majus" has always been regarded as the most important of Bacon's writings. It was written in the year 1267, and sent to Pope Clement IV. in consequence of the desire expressed by that Pontiff that Bacon would communicate to him the substance of his researches. A beautiful MS. of the work exists in the Library of Trinity College, Dublin, and from this MS. it was edited by Samuel Jebb, at London, in 1733. It is to this edition, or to the reprint of it at Venice, in 1750, that all the historians of philosophy have referred. The work, as published by Jebb, contains six parts, the subjects of which are as follows:—

In the first Bacon points out the four universal causes of human ignorance; in the second he treats of the relation of philosophy to theology; in the third, of grammar and the knowledge of languages; in the fourth, of mathematics, including astronomy and geography; in the fifth, of *perspectiva*, or optics; and in the sixth, of experimental science.

When Bacon had composed the "Opus Majus," he drew up a second treatise, similar in substance, which he called his "Opus Minus," and which he also transmitted to the Pope. His object in doing so was partly to guard against the risk of the "Opus Majus" being lost, from the dangers which then beset travellers, and partly to present to his Holiness, in a condensed and improved form, its most essential contents. Not satisfied with this precaution, he prepared a third version of his great work, which he named his "Opus Tertium," "ad intellectum et perfectionem utriusque operis præcedentis," and this also he transmitted to Clement. The two latter works have never been printed, but several copies of, at least, portions of them exist in the manuscript collections of Great Britain and continental Europe.

In the course of M. Victor Cousin's researches on the history of philosophy, he was led to examine a MS. of Bacon which existed in the library at Douai. He found that it contained a considerable portion of the "Opus Tertium." A lacuna which existed in this portion was supplied from a MS. in the British Museum, and the whole was carefully studied by M. Cousin. He was thus led to arrive at several very interesting conclusions respecting the life and writings of Bacon. His account of the "Opus Tertium," containing many extracts from the original, is to be found in the "Journal des Savants" for March, April, May, and June, of the year 1848. On the Introduction to the work, M. Cousin enlarges at great length. It gives a general outline of the plan of the whole work, and indicates the several subjects which were treated in the different parts of it. Among the other contents,—and to this I call your particular attention,—it mentions a regular and detailed treatise on moral philosophy. No such treatise is found in the Douai manuscript, which is imperfect at the end. But the statement that such a treatise formed part of the "Opus Tertium," would naturally lead us to suppose that the "Opus Majus" contained a similar treatise, for the two works, so far as we can compare them, run parallel to each other. M. Cousin, however, puts an end to all doubt on this question, by producing several passages of the "Opus Tertium," in which a seventh part of the "Opus Majus" is distinctly referred to, as containing discussions on moral subjects; and he therefore justly regards it as a fact established by his researches that the edition published by Jebb is incomplete, and that the "Opus Majus," in its integrity, had never been given to the world.

But thereupon arose a further interesting question, which M. Cousin was not in a condition to solve. It had been stated by Bale and Pits that Bacon was the author of a Treatise on Moral Philosophy. M. Cousin found, from the "Catalogi Codicum MSS. Angliæ et Hiberniæ," that a Treatise on Moral Philosophy was actually contained in the Library of Trinity College, Dublin; and, indeed, Jebb himself, while he describes in his preface the "Opus Majus" as *in sex partes distributum*, adds that the author "libros de prognosticis ex stellis et de multiplicatione specierum apposuit et *Tractatum de Morali Philosophia ad calcem adjunxit.*" Thus, as M. Cousin went on to say, the question was raised,—can it be that the Treatise on Moral Philosophy, contained in the Dublin Library, is really the missing seventh part of the "Opus Majus"? "On voit par là de quelle importance il serait de rechercher le traitè manuscrit de philosophie morale, ... car ce traitè serait tres-vraisemblablement la septieme partie de l' Opus Majus." And M. Cousin proceeds to recommend the examination of this moral treatise, and its publication, if it should turn out to be what he anticipated, to the scholars of the *English* Universities:—"Puisse cette entreprise, à la fois utile et facile, sourire au patriotisme de quelque savant d' Oxferd ou de Cambridge!"

My attention was called to these articles of M. Cousin by a very clear and well-written summary of his conclusions, which appeared in the first

volume of "Notes and Queries." It then occurred to me that my position as a member of Trinity College, Dublin, gave me the means of setting at rest this question, which has hitherto remained unanswered. And my principal object in making this communication to the Academy is to announce that, by a careful examination of the manuscript, I have been enabled to establish, that M. Cousin's anticipation is perfectly correct. The "Opus Majus" not only *had*, but in the Dublin manuscript still *has*, a seventh part devoted to moral philosophy.

This seventh part is of considerable length: the six parts printed by Jebb fill 406 pages in the manuscript; the seventh occupies 92 pages. It is written by the same hand as the earlier portion, and, like it, is filled with contractions. It begins on the same page on which the sixth part terminates. In fact, there is every appearance of perfect continuity with what precedes. It is headed, "Incipit septima pars hujus persuasionis, de Morali Philosophia"—a formula quite similar, with the single change of the number and subject, to those prefixed to the preceding parts. The first words are, "Manifestavi in præcedentibus," —which imply something before them. These are striking indications, exhibiting themselves at once on inspection. It might, however, be urged, that the latter only shows the treatise to form a part of some larger work, not necessarily of the "Opus Majus," and that the former might have arisen from the mistake of a transcriber; and Jebb's omission of the treatise in his edition naturally made me slow to attach importance to these *prima facie* evidences. But when the treatise is examined throughout, the truth becomes apparent. Every allusion to preceding matter, and such allusions are frequent, becomes perfectly clear on the hypothesis that we are reading a part of the "Opus Majus." It would be easy to multiply proofs of this kind: at present I will mention only a few, which, however, appear decisive:—

In the opening pages of the treatise Bacon enumerates the subjects treated in the first six parts of the "Opus Majus," in the order in which they occur in that work, and in doing so speaks of their utility "relate ad Dei Ecclesiam et cætera tria prænarrata." Now to understand this phrase we must go back to the first page of the "Opus Majus," where this sentence occurs:—"Per lumen sapientiæ ordinatur Ecclesia Dei, respublica fidelium disponitur, infidelium conversio procuratur, et illi qui in malitia obstinati sunt, valent per virtutem sapientiæ reprimi. . . . . Omnia vero quæ indigent regimine sapientiæ ad hæc quatuor reducuntur." The idea of these four ends is reproduced frequently through the "Opus Majus," and may be said to be woven into its texture. And the reference, "cætera tria prænarrata," is strictly similar to those throughout the whole "Opus Majus," in which the opening passage is recalled,—such, for example, as that which is found in page 58 of Jebb's edition,—"sicut ad Ecclesiam Dei et cætera tria comparantur."

Again, in fol. 242 of the manuscript, when proving the necessary existence of seven sects only, including that of Antichrist, he says:—"*Superius* in comparatione Mathematicæ ad Ecclesiam revolutæ sunt

sectæ." Now the passage here referred to is found in a part of the "Opus Majus" devoted to that general subject, and may be read at page 160 of Jebb's edition.

In fol. 245 of the MS., speaking of the reception given by a Tartar emperor to the monk William, author of a treatise "De moribus Tartarorum," he adds, "de quo superius tactum est in his quæ de locis mundi dicta sunt." He here plainly refers to a passage at page 232 of Jebb's edition, in the part of the "Opus Majus" which relates to geography.

Again, in fol. 246, a passage occurs which fixes the date of the treatise. Six hundred and sixty-five of the destined years of the duration of Mahometanism are there said to have elapsed, which, by changing Arabian lunar years of the era of the Hegira into solar years of the Christian era, gives us the date 1267. To this statement Bacon adds the words, "sicut superius in mathematicis est notatum." Now the same chronological statement is found at page 167 of Jebb's edition, with this difference only, that while in Jebb the phrase used is "nunc est annus sexcentesimus sexagesimus quintus," in the moral treatise the phrase is, "Jam transierunt anni sexcenti sexaginta quinque," indicating, apparently, that one of these years had closed in the interval between the composition of the two passages.

But if it should be urged that these correspondences, and the use of such words as *prius* and *superius*, may be explained on the hypothesis that the moral treatise is not *a part* of the "Opus Majus," but that, according to Jebb's expression, it was *ad calcem adjunctus*, let me refer you to a passage in fol. 205, where, after making a statement of the prophets and patriarchs having treated divine things not only theologically, but philosophically, he adds, "sicut in secunda parte *hujus operis* probatum est." Now the corresponding passage is found in the second part of the "Opus Majus," at page 30 of Jebb's edition.

It is thus, I think, fully established that the moral treatise of which I have been speaking is really the Seventh part of the "Opus Majus." When I consider the weight of the evidence which has led me to this conclusion, the omission of it by Jebb, in his edition, appears to me one of the most curious circumstances in literary history.

And here I cannot refrain from observing that serious injustice has been done to Bacon by the suppression of this portion of his work in the printed copies. For the cardinal idea which presided over his whole construction is thus kept out of view, or at least obscured. This idea was, the supremacy of moral science over the rest of the intellectual system. The earlier and simpler sciences he regarded as deserving of study, chiefly because they are the necessary preparation for Morals, the supreme and final science. This view, often put forward throughout the book, is nowhere more nobly stated than in the following decisive sentence, which occurs in the Seventh part:—"Non quæruntur scientiæ cæteræ nisi propter istam quæ est humanæ sapientiæ dominatrix."

I will now proceed to give a very rapid sketch of the general divisions of the Seventh part. And my object in doing so is to establish

the second conclusion at which I have arrived, namely, that the Seventh part, though extending to more than ninety folio pages, is yet imperfect in the Dublin manuscript. This I did not at first suspect. There is indeed no "Explicit" at the end of the manuscript, which closes at the middle of the page; but that might be an accidental omission; and in the sense of the concluding passage there is nothing, at first view, to indicate an abrupt termination. The final words, "Et quid potest homo plus petere in hac vita?" might even seem not inaptly to mark the completion of the great edifice. But, on further examination, using the lights supplied by M. Cousin's account of the "Opus Tertium," I have arrived at the conclusion that there is a deficiency at the end of the manuscript.

A few brief quotations will best indicate the general plan of the moral treatise which forms the Seventh part. After some excellent introductory observations on the relation between moral philosophy and the preceding sciences, he goes on to enumerate the several heads or branches of the subject to be successively treated:—"Hæc scientia primo docet componere leges et jura vivendi, secundo docet ea credi et probari, et homines exhortari ad operandum et vivendum secundum illas leges." He proceeds to state the subdivision of the first head into three:—"Prima pars dividitur in tres, nam primò naturaliter occurrit ordinatio hominis in Deum et respectu substantiarum angelicarum, secundo ad proximum, tertio ad seipsum." And accordingly these three branches of moral duty are the subjects of the first three divisions of the treatise. Thus, having spoken in the first of our duty to God, in fol. 210 he commences the second division with the words,—"Secunda pars descendit ad leges et statuta hominum inter se." This division is very brief, occupying only two pages. Then begins the third, which is thus characterized:—"Tertia vero pars scientiæ moralis et civilis est de moribus cujuslibet personæ secundum se, ut honestas vitæ in quolibet habeatur, et turpitudo vitiorum relinquatur propter futuram felicitatem et horrorem æternæ pœnæ." This division is of great extent, abounding in lengthened quotations from the ancient ethical writers, particularly Seneca, with some of whose works the author says he had recently met for the first time. "Protraxi," he proceeds, in fol. 240, "hanc partem Philosophiæ moralis gratis propter pulchritudinem et utilitatem sententiarum moralium, et propter hoc quod libri raro inveniuntur a quibus erui has morum radices, flores, et fructus." "Nunc autem volo accedere ad partem quartam hujus scientiæ." And in the fourth division the question is considered, what sect is to be adopted and followed by mankind,—in other words, what is the true religion? Having proved Christianity to be the faith which the human race ought to receive, he proceeds to establish that doctrine of the Christian faith which he says most requires to be defended, "eo quod quidam negant et aliis est dubium, alii cum difficultate recipiunt, quibusdam durum videtur, alii imperfecte sentiunt, pauci de facili et cum plena pace et suavitate animi tenent, et est hoc sacramentum altaris." And then follows a discourse on the doctrine of the Eucharist, with which the treatise ends.

Now I think it is pretty plain that Bacon's own programme has not been carried out if the treatise, as existing in the manuscript, is to be taken as complete. For though that portion of the second general head which represents moral philosophy as "docens leges et jura vivendi credi et probari," may be regarded as sufficiently elaborated, the other part, in which it is spoken of as "docens homines exhortari ad operandum et vivendum secundum illas leges," is certainly not forthcoming.

But the suspicion thus awakened becomes certainty when we examine some passages of the "Opus Tertium," of which M. Cousin has given an account. For, in the Introduction to that work, of which I spoke before, in which a prospective view, as you will remember, is given of the subsequent portions of the work, the divisions of the moral part are enumerated. Of these there are stated to be six. The first (I use M. Cousin's abstract, for he does not quote the original Latin) related to the belief and conduct of man with respect to God, to the future life, &c.; the second was on public law, on the public worship of God, and on the government of states; the third was on the beauty of virtue and the deformity of vice; the fourth, on the different religions of the world, for the purpose of proving that one only is true, and ought to be universally diffused; the fifth contained exhortations to the performance of the duties imposed by the religion whose truth had been established; and the sixth had reference to the organization of tribunals and the administration of justice. Now, bearing in mind that the "Opus Tertium" follows the plan of the "Opus Majus," we may assume that the arrangement adopted in the former was used in the latter work also And accordingly, you will observe that the first four divisions just mentioned strictly coincide with those which I described as occurring in the Seventh part of the "Opus Majus." It may, therefore, I conclude, be safely announced that the fifth and sixth divisions of the Seventh part are wanting in the Dublin manuscript.

It would, perhaps, be premature to print the Seventh part until the necessary researches have first been made to ascertain whether or not it can be completed from manuscripts in British or foreign libraries. In the meantime, having made considerable progress in the study of the portion which the Dublin manuscript comprises, I hope before long to lay before the Academy a full account of its contents, extracting everything which appears interesting either from its intrinsic merit, or as affording information on the state of learning and philosophical opinion in the thirteenth century.

I cannot conclude without repeating my protest against the continued neglect with which the writings of this great man have hitherto been treated. Many tracts attributed to him are to be found in our manuscript collections, which ought now at length to be examined, arranged, and published, with the necessary historical and other elucidations. From my own observations on the initial sentences of these tracts, which are sometimes given in the catalogues, I am convinced that many of them are simply extracts from the three great works which he addressed to Pope Clement. And I believe that if the "Opus Majus,"

the "Opus Minus," and the "Opus Tertium," were printed in a form as complete as the existing copies would permit, but little would remain in manuscript that proceeded from the hand of Roger Bacon.

A list of Presentations to the Library was read, and thanks returned to the several donors.

MONDAY, FEBRUARY 8, 1858.

James Henthorn Todd, D.D., President, in the Chair.

Samuel L. Hardy, M. D., was elected a Member of the Academy.

On the recommendation of the Council, it was resolved that the Treasurer be authorized to sell a portion of the funded Stock of the Academy, not exceeding £50, in order to make up the sum required for payment for the Cunningham Medals awarded in the present year.

The President read a paper—

ON SOME ANCIENT IRISH DEEDS.

These deeds are mostly in the Irish language and character, of the fifteenth, sixteenth, and seventeenth centuries. They are of the nature of deeds of mortgage, wills, covenants, deeds of arbitration, indentures, deeds of partition, conveyance of land; and some of them are Brehon Law judgments.

No. 1—Is dated A.D. 1450, and also by the local historical fact, "the year in which Donoch O'Brien died."

It is a deed of mortgage by deed poll, but differs from our modern deeds of mortgage in that it does not convey the lands. It consists of five parts. In Part I. it is recited that Donnell Oge O'Kearney had possession of the lands of Ballymote, or rather a half quarter of them, for a debt due to him by the owners, Teige Mac Sida (Mac Sheedy), [Mac Namara], and his son. But Teige and his son seem to have been in debt to Donoch O'Brien [first Earl of Thomond ?], whose bailiffs entered the lands of Ballymote, then in the possession of Donnell Oge O'Kearney, and carried off three valuable mares. Arbitrators were appointed, and Teige Mac Sheedy and his son were condemned to pay five marks to O'Kearney. As security for these five marks, Mac Sheedy, the son, mortgages a half quarter of Ballymote to O'Kearney.

In Part II. it is stated that Mac Sheedy, the son, had been murdered by Donnell Oge Mac Namara, but had by his will left his property to his brother and chief, Donnell Derg [or the red], subject to the debts due to O'Kearney.

Part III. is a further mortgage. Donnell Derg, and the two sons of Lochlainn O'Curry, had stolen two pigs from O'Kearney; an arbitration was agreed to, and a fine of half a mark given for the pigs, with three *uinge* as costs, and one *uinge* as a twelfth, or umpires' fees. To meet these charges, Donnell Derg mortgages the lands to the amount of one mark.

These facts enable us to fix the price of pigs in that golden age in Ireland. The mark was two-thirds of £1, or 13*s.* 4*d.*, and consequently the two pigs, being valued at half a mark, were worth 3*s.* 4*d.* each. The other half mark was equal to four *uinge,* or ounces, and one *uinge* is called *the twelfth,* i. e., the twelfth of a pound [of gold?]. An *uinge* must, therefore, have been 1*s.* 8*d.*

Part IV. The pig transaction does not seem to have permanently broken friendship between O'Kearney and Donnell Derg; for the former appears to have lent the latter a sum of money, secured by a further mortgage on the lands.

Part V. Donnell Derg, however, engaged in gambling, but lost eight marks, and his person appears to have been seized by Hugh Roe Mac Namara, and Owen of the Money, the successful gamblers. He was ransomed by Teige Mac Donnell Mac Namara, who gave a good steed for him to the gamblers; so that the price of a good steed in those days was about £5 6*s.* 8*d.*

Mac Namara, however, owed O'Kearney one *uinge* of gold and six marks for three milch cows; and the rescued gambler, Donnell Derg, mortgaged his lands still further to the prudent O'Kearney, to discharge this portion of his debt to Mac Namara. The lands concerned in this document are situated near Sixmilebridge, county of Clare, and the same remark applies to the next two deeds.

No. 2—Is another deed, of the nature of a mortgage on the lands of Kill Fiontanain, dated August 11, 1612.

No. 3—Is a statement of the debts or demands of Conor Mac Teige upon the clan Mac Craith, out of the lands of the Lower Corbally. (No date.)

No. 4.—The will of Mortogh Mac Mahon, written after his death by the testamentary priests who were present at his death-bed; it is little more than an acknowledgment of his debts due to Donn Mac Gorman. (Not dated.) He appears to have lived in the neighbourhood of Kilrush, county of Clare.

No. 5.—A deed of mortgage (1549), on the lands of Donnell Oge O'Kearney (see No. 1), to Mac Con Mac Lochlainn, son of Sida [M'Namara]. [The date shows that the Donnell Oge O'Kearney here mentioned must have been the son or grandson of the personage mentioned in No. 1.]

No. 6.—An endorsement on No. 5, dated also 1549, containing a power of redemption, and liberty to O'Kearney to carry off manure from the land, "if there be manure upon it."

No. 7. A deed of arbitration respecting the lands of Garry Orrtha, between Conor Mac Teige and Mac Craith Mac Teige, dated A.D., 1587.

No. 8.—An endorsement on the former, much obliterated.

No. 9.—A deed of indenture, dated 1551, conveying half the land and inheritance of Murchu, son of Conor, son of Murchu, son of William, of Bally Sidhnoidh for ever, to Philip and Conor, the two sons of Conor, son of Teige, and their heirs after them; and a sort of mortgage of the

other half of his land to Philip and to Dermot, to whom Murchu promises to pay a rent, whenever "he is able to sit in the land," and if not able "to sit" in it, then Philip and Dermot were to pay him a rent. This document is subscribed by Murchu O'Mulregan, Conor O'Dwyer, William O'Davoren, Shane O'Dwyer, and Philip O'Dwyer.

No. 10.—A mortgage, dated 1587, to Conor, son of Teige [O'Dwyer?] and Eogan, son of Donnell, on the lands of Matthew, son of Murchu [O'Mulregan].

No. 11.—A mortgage, dated 1576, to Conor, son of Teige, son of William [O'Dwyer], on two-thirds of the lands of Dromainn-an-Chunna, from Matthew, son of Murchu, son of Conor [O'Mulregan]. This deed contains two singular covenants:—1st. That Matthew is to have an invitation at Easter and Christmas, "upon Conor, and upon Eoghan, son of Donnell." And 2nd. "If it shall happen to Matthew to fall into poverty or distress, Conor and Eoghan are to give him food and clothing, Conor paying two-thirds, and Eoghan one-third, of the burthen, and Matthew doing the utmost service to them on that account."

No. 12.—A mortgage, not dated.

No. 13.—An endorsement on No. 12, dated 1531. These are of no particular interest, except that the payment is made in cows, and no mention made of money. The parties seem to belong to the same families of O'Dwyer and O'Mulregan, who are concerned in Nos. 9, 10, and 11. Nos. 7 to 13 inclusive relate to a district in the county of Tipperary, on the borders of the county of Limerick.

No. 14.—A deed in Latin, nearly obliterated.

No. 15.—A deed of arbitration, in Irish, dated 8th Oct. 1584, containing a very full and formal statement of the names of the parties concerned, the cause of controversy, and the decision of the arbitrators. The original is in Mr. Curry's collection, and is a very remarkable and valuable specimen of a decree of arbitrators under the Brehon Law between two parties of the O'Kennedys of Lower Ormond, county of Tipperary.

No. 16.—This is very nearly in the form of a modern deed poll, dated 19th July, 1611. It is a lease for twenty-one years, of the western half of the lands of Moy Lacha, parish of Kilrush, barony of Clonderala, county of Clare, from Turloch Roe Mac Mahon, to Shane, son of Teige O'Gilltinane, and after the expiration of the term of twenty-one years, "until redeemed by the payment of ten pounds of the crowned money of the Saxons, of good metal and pure silver." This deed contains a formal clause of re-entry, the appointment of a bailiff to give possession, and a covenant for peaceable possession.

There is also a remarkable covenant in which Turloch Mac Mahon, the lessor, acknowledges himself bound "to put this writing into the force of the law of the Saxon king, as the law adviser of the above Shane may advise."

The originals of this and of the five following are in Mr. Curry's collection.

No. 17.—A curious document, evidently founded on Brehon Law, but

not dated. It is a statement of certain personal and other injuries inflicted upon Teige, son of Sioda, or Mac Sheedy, by Fingin, son of Mac Con, and his family. It is a kind of bill of indictment.

No. 18.—A deed of arbitration for certain injuries inflicted on Donnell, son of Rory, by the sons of Lochlainn, son of Fingin, son of Donnchadh [Mac Namara.] These personages appear to have lived in the neighbourhood of Cratloe (county of Clare); and the outrages which gave occasion to the arbitration were committed "in the summer in which Murchadh O'Brien and Donnchadh O'Brien went to England."

The deed was executed in 1550. Nos. 17 and 18 relate to the Mac Namaras mentioned in No. 1.

No. 19.—This document, dated 1591, is a curious compact, in which the descendants of Melachlainn O'Lochlainn of Ballymachane [in Burren, county of Clare], acknowledge themselves bound to Donnchadh O'Brien, by the terms of a compact made with their family by Connor, son of Turloch O'Brien, grandfather of the then Earl of Thomond. In this covenant they acknowledge themselves tenants of certain lands and vassals under the Earl; and he, on the other hand, concedes to them what would now be called tenant-right:—

"I, the Earl of Thomond, acknowledge upon my honour that I have promised that whenever lands or castles belonging to these people shall be brought to an end" [meaning, it is presumed, by the expiration of their lease or tenancy], "I will give them the appraisement of Boece [Mac Egan] and John O'Tierney and Eoghan O'Daly."

No. 20.—A deed of partition, dated April 3, 1675, between Aedh and Cosney, the sons of Gillananoemh Oge O'Davoren, of certain lands of their ancestors, situate in the district of Burren, county of Clare. This document provides that if any part of the lands be lost to the parties, they are to balance the loss with each other, in the same way as in the original partition. Also, that neither party has a right to put away his portion in pledge or perpetuity, so that the other cannot redeem it; also, that if any part of the lands be in pledge, whoever is first able to redeem it shall hold it until redeemed by the other; and if one party shall fail to have heirs, the other shall succeed to his portion of the property. Lastly, that if there be any part of Aedh's land which he is unable to occupy, Cosney shall, if able, occupy it without let or hindrance from Aedh.

No. 21.—An agreement between Donnell Oge O'Kearney and Graine, daughter of Mac Con [Mac Namara]. Donnell had a mortgage upon the lands of Graine [situate near Six-mile-bridge, county of Clare], to the amount of eleven uinge, with a right to two free cows; the lady being advanced in years, gives up her rights and her lands to Donnell, on the condition that he supports her, with power to her son, and to him only, to redeem the lands after her death; but if there be manure or buildings on the lands, they shall be appraised and redeemed according to appraisement. Here is another recognition of tenant-right. This document is dated 1522.

No. 22—Is a copy of a deed, made by Mr. Curry from the original, in the British Museum (Egerton, No. 139, p. 179). It is an agreement dated 1510. Lochlainn Riabhach O'Mullona [Mullowney] mortgaged his lands to Shane O'Radan for four cows, in calf, and a good male pig; and Shane O'Radan gives Connor O'Gleeson the privilege of having four free cows on the land until it is redeemed.

No. 23.—This is a judgment of four Brehons in a controversy respecting land. The Brehons were of the family of O'Deoradan, Domhnall, Cathal Ferganainm, and Giolla Patrick; and the contending parties were, Gerald, son of Cathal Carrach; Brian, son of Murtoch; and Donnchadh, son of Crimhthan. Witnesses were examined upon oath, and the Brehons, acting upon their testimony, decide; and in an appendix to their decision minutely describe the boundaries of the land. The decision is as follows:—

"And in accordance with that" [viz., the evidence], "the Brehons gave it as a judgment that Gerald should have possession of the land, and that neither Teige nor Donnchadh should have any claim on it from that time forth. And the one-eighth part of the sheaf of that year was awarded to Donnchadh in payment for his labour."

This decision is dated 1560, showing that the Brehon Law continued to be practised in some parts of Ireland to that period; and it can be proved to have continued at least 100 years later. The original is in the Library of Trinity College (H. 3, 18, p. 455). The lands and parties mentioned in this document belonged to the county of Wexford.

No. 24—Is a letter of confraternity, in Latin, granted by Patrick Culvyn, local Prior of Dublin, of the order of Friars Eremite of St. Augustine, to John Stackpoole, and Genet Gwyth, his wife. Dated 31st of August, 1507.

Dr. Todd then made some remarks on the historical and antiquarian value of the deeds described, and exhibited to the Academy some of the deeds, together with a MS. book containing transcripts (made by Mr. Curry for the University Library), in which the whole are written, without the contractions of the originals, and rendered accessible to ordinary readers of Irish.

The following antiquities were presented to the Museum:—

By Alderman Fergus Farrell:—An ancient cinerary urn, and fragments of another, found with human bones, about three feet under the surface, and covered with a large stone, in the shape of a millstone, on the lands of Carrickbanagher, county of Sligo.

By W. R. Wilde, Esq.:—1. A bronze bridle ornament, from Emly [Imleach Brocadha, so called from St. Brocadius, a disciple of St. Patrick], near Castlerea, county of Roscommon. 2. A pair of pampootees, from the Island of Aran.

By Dr. Dowsley, of Clonmel:—A cast in plaster from the Roman oculist's stamp, found in the county of Tipperary, and referred to in the "Catalogue of the Museum," at page 126.

Lord Talbot de Malahide presented fourteen several volumes of the works of Dominic Sestini on Numismatics, printed at Milan, Florence, Pisa, and Berlin.

MONDAY, FEBRUARY 22, 1858.

James Henthorn Todd, D. D., President, in the Chair.

The Rev. George Salmon read a paper by Mr. Cayley,—

ON THE THEORY OF RECIPROCAL SURFACES.

The present note is intended to be supplementary to Mr. Salmon's memoir "On the Degree of a Surface reciprocal to a given one" (Trans. R. I. A., vol. xxi. pp. 461–488; 1857). I find that Mr. Salmon's equations admit of a transformation which appears important in reference to the geometrical theory, and the object of the note is to present the system of equations under the new form.

Mr. Salmon writes—

n, the order of the surface.

a, the order of the tangent cone drawn from any point to the surface.

δ, the number of the double edges of the cone.

κ, the number of its cuspidal edges.

b, the order of any double curve upon the surface.

k, the number of apparent double points of the double curve.

t, the number of triple points on the double curve.

c, the order of any cuspidal curve on the surface.

h, the number of apparent double points of the cuspidal curve.

β, the number of intersections of the double and cuspidal curves which are stationary points on the cuspidal curve.

γ, the number of intersections which are stationary points on the double curve.

i, the number of intersections which are not stationary points upon either curve.

ρ, the number of the points where the double curve is met by the curve of contact of the tangent cone.

σ, the number of the points where the cuspidal curve is met by the curve of contact.

And the accented letters denote the corresponding singularities of the reciprocal surface, or, if we choose that they should refer to the given surface, and its tangential or *class* singularities, then we have—

n', the class of the surface.

a', the class of the curve of intersection by any plane.

δ', the number of double tangents of the curve.

κ', the number of its cusps.

b', the class of the node-couple develope.

k', the number of apparent double planes of the node-couple develope.

t', the number of triple planes of the node-couple develope.

c', the class of the spinode develope.

h', the number of the apparent double planes of the spinode develope.

β', the number of common tangent planes of the node-couple and spinode developes, stationary planes of the spinode develope.

γ', the number of common tangent planes, stationary planes of the node-couple develope.

i', the number of the common tangent planes which are not stationary planes of either develope.

ρ', the number of the common tangent planes of the node-couple develope, and the tangent cone.

σ', the number of the common tangent planes of the spinode develope, and the tangent cone.

The terminology made use of is that of my paper "On the Singularities of Surfaces" ("Cambridge and Dublin Mathematical Journal," vol. vii., 1852). To explain it, I need only remark that the term node is used as synonymous with double point, and the term spinode as synonymous with cusp; a spinode plane is a tangent plane meeting the surface in a curve, having a spinode at the point of contact; and a node-couple plane is a double tangent plane, or plane meeting the surface in a curve having two nodes; the term develope is used instead of developable surface.

To collect all the formulæ, it is proper to write also—

r, the class of the cuspidal curve.

q, the class of the double curve.

r', the order of the spinode develope.

q', the order of the node-couple develope.

Where q' is what Mr. Salmon, who only uses it incidentally in referring to a result of Professor Schläfli's, calls, after him, A.

Mr. Salmon obtains, between the twenty-eight quantities—

$$n,\ a,\ \delta,\ \kappa,\ b,\ k,\ t,\ c,\ h,\ \beta,\ \gamma,\ i,\ \rho,\ \sigma,$$
$$n',\ a',\ \delta',\ \kappa',\ b',\ k',\ t',\ c',\ h',\ \beta',\ \gamma',\ i',\ \rho',\ \sigma',$$

the twenty-one equations,

$$a = a',$$

$$a' = n(n-1) - 2b - 3c,$$
$$\kappa' = 3n(n-2) - 6b - 8c,$$
$$\delta' = \tfrac{1}{2}n(n-2)(n^2-9) - (n^2-n-6)(2b+3c) + 2b(b-1) + 6bc + \tfrac{9}{2}c(c-1),$$

$$a(n-2) = \kappa + \rho + 2\sigma,$$
$$b(n-2) = \rho + 2\beta + 3\gamma + 3t,$$
$$c(n-2) = 2\sigma + 4\beta + \gamma,$$

$$a(n-2)(n-3) = 2\delta + 2ab + 3ac - 4\rho - 9\sigma,$$
$$b(n-2)(n-3) = 4k + ab + 3bc - 9\beta - 6\gamma - 3i - 2\rho,$$
$$c(n-2)(n-3) = 6h + ac + 2bc - 6\beta - 4\gamma - 2i - 3\sigma,$$

$$n' = n(n-1)^2 - n(7b+12c) + 4b^2 + 9c^2 + 8b + 15c - 8k - 18h + 18\beta + 12\gamma + 12i - 9t,$$

$$\begin{aligned}
a &= n'(n'-1) - 2b' - 3c',\\
\kappa &= 3n'(n'-2) - 6b' - 8c',\\
{*}\ \delta &= \tfrac{1}{2}n'(n'-2)(n'^2-9) - (n'^2-n'-6)(2b'+3c') + 2b'(b'-1) + 6b'c' + \tfrac{9}{2}c'(c'-1),
\end{aligned}$$

$$\begin{aligned}
a'(n'-2) &= \kappa' + \rho' + 2\sigma',\\
b'(n'-2) &= \rho' + 2\beta' + 3\gamma' + 3t',\\
c'(n'-2) &= 2\sigma' + 4\beta' + \gamma',
\end{aligned}$$

$$\begin{aligned}
a'(n'-2)(n'-3) &= 2\delta' + 2a'b' + 3a'c' - 4\rho' - 9\sigma',\\
b'(n'-2)(n'-3) &= 4k' + a'b' + 3b'c' - 9\beta' - 6\gamma' - 3i' - 2\rho',\\
c'(n'-2)(n'-3) &= 6h' + a'c' + 2b'c' - 6\beta' - 4\gamma' - 2i' - 3\sigma',
\end{aligned}$$

$$* \ n = n'(n'-1)^2 - n'(7b'+12c') + 4b'^2 + 9c'^2 + 8b' + 15c' - 8k' - 18h' + 18\beta' + 12\gamma' + 12i' - 9t';$$

to which may be joined—

$$\begin{aligned}
q &= b^2 - b - 2k - 3\gamma - 6t,\\
r &= c^2 - c - 2h - 3\beta,\\
q' &= b'^2 - b' - 2k' - 3\gamma' - 6t',\\
r' &= c'^2 - c' - 2h' - 3\beta'.
\end{aligned}$$

Considering the twenty-one equations, and taking as data $n, b, c, \beta, \gamma, h, k$, then, by means of the several equations, other than the two equations marked (*), we may express in terms of the above data $a, \delta, \kappa, t, i, \rho, \sigma, n', a', \delta', \kappa', b', c', \rho', \sigma', 2\beta' + 3\gamma' + 3t', 4\beta' + \gamma', 4k' - 3i', 6h' - 2i'$; the quantities which enter into the first of the marked equations are then all given in terms of the above data, and it is clear that the equation must be satisfied identically: the quantities which enter into the second of the marked equations are given in terms of the data and of t', i', and it is not clear, *a priori*, but that the equation might lead to a relation between the data and t', i'; it will, however, appear in the sequel that the equation must be satisfied identically, independently of any particular values of t', i'. Thus, Mr. Salmon's theory does not determine the values of these two quantities, nor, consequently, the values of β', γ', h', k'; it does, however, determine the values of the combinations $4\beta' + \gamma'$, $8k' - 18h'$. But the twenty-one equations between the twenty-eight quantities may be replaced by seventeen equations between the twenty quantities—

$$\begin{gathered}
n,\ a,\ \delta,\ \kappa,\ b,\ c,\ \rho,\ \sigma,\ 4\beta+\gamma,\ 8k-18h,\\
n',\ a',\ \delta',\ \kappa',\ b',\ c',\ \rho',\ \sigma',\ 4\beta'+\gamma',\ 8k'-18h',
\end{gathered}$$

this will clearly be the case if it is only shown that the equation which gives n' can by the other equations be transformed into one of the form in question; for a similar transformation will, of course, apply to the equation for n, and then we have only to reject the equation containing

t, and to replace the two equations which contain i, by the equation given by the elimination of this quantity, and in like manner to reject the equation containing t', and to replace the two equations containing i', by the equation given by the elimination of this quantity, and the system will be reduced to the required form.

The reduction of the equation which gives n' is effected as follows, we have—

$$\begin{aligned}(2b+3c)(n-2)(n-3) &= 8k+18h+a(2b+3c)+12bc-36\beta-24\gamma\\ &\qquad -12i-4\rho-9\sigma,\\ 3b(n-2) &= 6\beta+9\gamma+9t+3\rho;\end{aligned}$$

and thence—

$$\begin{aligned}&(2b+3c)(n-2)(n-3)+3b(n-2)\\ &=a(2b+3c)+12bc+8k+18h-12i+9t-\rho-9\sigma-30\beta-15\gamma\\ &=a(2b+3c)+12bc+8k+18h-12i+9t-18\beta-12\gamma-\rho-9\sigma-3(4\beta+\gamma);\end{aligned}$$

and consequently—

$$\begin{aligned}&-8k-18h+18\beta+12\gamma+12i-9t\\ &=\{a-(n-2)(n-3)\}(2b+3c)-3b(n-2)+12bc\\ &\quad-\rho-9\sigma-3(4\beta+\gamma),\end{aligned}$$

which (observing that the left-hand side is precisely the combination of terms which enters into the equation for n') shows that the reduction is possible; to complete it, putting for a its value $n(n-1)-2b-3c$, we have—

$$\begin{aligned}&-8k-18h+18\beta+12\gamma+12i-9t\\ &=b(5n-6)+c(12n-18)-4b^2-9c^2-\rho-9\sigma-3(4\beta+\gamma);\end{aligned}$$

and substituting this value in the equation for n', we obtain

$$n'=n(n-1)^2-b(2n-2)-3c-\rho-9\sigma-3(4\beta+\gamma).$$

Some of the other equations admit of simplification: the equation

$$a(n-2)(n-3)=2\delta+a(2b+3c)-4\rho-9\sigma,$$

if we put for a its value $n(n-1)-2b-3c$, becomes—

$$(4n-6-2b-3c)(n-2)(n-3)=2\delta-4\rho-9\sigma,$$

and the prescribed combination

$$(2b-3c)(n-2)(n-3)=8k-18h+a(2b-3c)-4\rho+9\sigma,$$

gives in like manner, putting for a its value

$$(-n^2+n+4b)(n-2)(n-3)=(8k-18h)-4\rho+9\sigma.$$

The system of seventeen equations then is—

$$
\begin{aligned}
&a = a'\\
&a' = n(n-1) - 2b - 3c,\\
&\kappa' = 3n(n-2) - 6b - 8c,\\
&\delta' = \tfrac{1}{2}n(n-2)(n^2-9) - (n^2-n-6)(2b+3c) + 2b(b-1) + 6bc + \tfrac{9}{2}c(c-1),
\end{aligned}
$$

$$
\begin{aligned}
&a(n-2) = \kappa + \rho + 2\sigma,\\
&c(n-2) = 2\sigma + (4\beta+\gamma),
\end{aligned}
$$

$$
\begin{aligned}
&(4n-6-2b-3c)(n-2)(n-3) = 2\delta - 4\rho - 9\sigma,\\
&(-n^2+n+4b)(n-2)(n-3) = (8k-18h) - 4\rho + 9\sigma,
\end{aligned}
$$

$$
\begin{aligned}
&n' = n(n-1)^2 - b(2n-2) - 3c - \rho - 9\sigma - 3(4\beta+\gamma),\\
&a = n'(n'-1) - 2b' - 3c',\\
&\kappa = 3n'(n'-2) - 6b' - 8c',\\
{}^*&\delta = \tfrac{1}{2}n'(n'-2)(n'^2-9) - (n'^2-n'-6)(2b'+3c') + 2b'(b'-1) + 6b'c' + \tfrac{9}{2}c'(c'-1).
\end{aligned}
$$

$$
\begin{aligned}
&a'(n'-2) = \kappa' + \rho' + 2\sigma',\\
&c'(n'-2) = 2\sigma' + (4\beta'+\gamma'),
\end{aligned}
$$

$$
\begin{aligned}
&(4n'-6-2b'-3c')(n'-2)(n'-3) = 2\delta' - 4\rho' - 9\sigma',\\
&(-n'^2+n'+4b')(n'-2)(n'-3) = (8k'-18h') - 4\rho' + 9\sigma',
\end{aligned}
$$

$$
{}^*n = n'(n'-1)^2 - b'(2n'-2) - 3c' - \rho' - 9\sigma' - 3(4\beta'+\gamma').
$$

We may here take as data n, b, c, $4\beta+\gamma$, $8k-18h$, the equations exclusively of the two marked (*), then give a, δ, κ, ρ, σ, n', a', δ', κ', b', c', ρ', σ', $4\beta'+\gamma'$, $8k'-18h'$; and then, since all the quantities entering into the two excepted equations are expressed in terms of the data, these equations are satisfied identically, and it is easy to see that this proves what was before assumed, viz., that in the system of twenty-one equations, the second of the equations marked (*) is satisfied identically.

Several of the other quantities may be expressed without difficulty in terms of the data n, b, c, $4\beta+\gamma$, $8k-18h$: we in fact have (besides a, a', κ', δ', which are originally so expressed)—

$$
\begin{aligned}
2\sigma &= (n-2)c - (4\beta+\gamma),\\
8\rho &= (16n-24)b - (15n-18)c - 2(4b^2-9c^2) + 2(8k-18h) - 9(4\beta+\gamma),\\
8\kappa &= 8n(n-1)(n-2) - (32n-56)b - (17n-46)c\\
&\quad + 2(4b^2-9c^2) - 2(8k-18h) + 17(4\beta+\gamma),
\end{aligned}
$$

$$
\begin{aligned}
2\delta &= n(n-1)(n-2)(n-3) - (4n^2-20n+24)b - (6n^2-15n+18)c\\
&\quad + 12bc + 18c^2 + (8k-18h) - 9(4\beta+\gamma),
\end{aligned}
$$

$$
\begin{aligned}
8n' &= 8n(n-1)^2 - (32n-40)b - (21n-30)c\\
&\quad + 2(4b^2-9c^2) - 2(8k-18h) + 21(4\beta+\gamma),
\end{aligned}
$$

$$
\begin{aligned}
&= 4n(n-1)(n-2) - (16n-28)b - (10n-26)c\\
&\quad + (4b^2-9c^2) - (8k-18h) + 10(4\beta+\gamma),
\end{aligned}
$$

but the expressions for the remaining quantities, viz., b', ρ', σ', $4\beta'+\gamma'$, $8k'-18h'$ would be very complicated. If we suppose that b, c, $4\beta+\gamma$, $8k-18h$, vanish, or, what is the same thing, attend only to the terms which contain n alone, we have—

$$
\begin{aligned}
2b' &= n(n-1)(n-2)(n^3-n^2+n-12),\\
\rho' &= n(n-2)(n^3-n^2+n-12),\\
\sigma' &= 4n(n-2),\\
4\beta'+\gamma' &= 4n^2(n-2)(n^3-3n^2+3n-3),
\end{aligned}
$$

$$
\begin{aligned}
8k'-18h' = n(n-2)\,(n^{10}-6n^9+16n^8-54n^7+164n^6-288n^5+403n^4\\
-482n^3+348n^2-242n+60),
\end{aligned}
$$

which agree with the values which Mr. Salmon has obtained for β', γ', h', k' by means of the twenty-one equations, and the additional equations (peculiar to the case in question, of a surface of the degree n without singularities, and which are obtained by him from independent considerations), $i'=0$, and $\beta'=2n(n-2)(11n-24)$.

The system of seventeen equations completely accounts for the reduction of the order of the given surface considered as the reciprocal of the reciprocal surface, but the omitted equations are important for other purposes. We may by means of them express i, t in terms of the data for the system of twenty-one equations, viz., n, b, c, β, γ, h, k; and, effecting this, and annexing the corresponding values of i', t', we have the supplementary system—

$$
\begin{aligned}
4i &= (5n-6)c-6c^2+12h-5\gamma,\\
24t &= -(8n-8)b+(15n-18)c+2(4b^2-9c^2)-16k+36h+20\beta-15\gamma,\\
4i' &= (5n'-6)c'-6c'^2+12h'-5\gamma',\\
24t' &= -(8n'-8)b'+(15n'-18c')+2(4b'^2-9c'^2)-16k'+36h'+20\beta'-15\gamma,
\end{aligned}
$$

to which I annex also, without transformation, the four equations for q, r, q', r', viz.:—

$$
\begin{aligned}
q &= b^2-b-2k-3\gamma-6t,\\
r &= c^2-c-2h-3\beta,\\
q' &= b'^2-b'-2k'-3\gamma'-6t',\\
r' &= c'^2-c'-2h'-3\beta.
\end{aligned}
$$

The last two of which, neglecting singularities, give—

$$
\begin{aligned}
q' &= 4n(n-2)(n-3)(n^2+2n-4),\\
r' &= 2n(n-2)(3n-4),
\end{aligned}
$$

which are the values given by Mr. Salmon. I remark, in conclusion, that there is considerable difficulty in the geometrical conception of the points i and the planes i', and the subject appears to require further examination. In the case of a surface of the order n without multiple lines, we have not only $i=0$ (which is a matter of course), but also $i'=0$. In my paper before referred to, I showed, or attempted to show, by geo-

metrical reasoning, that the common tangent planes of the spinode develope and the node-couple develope are stationary planes of the one or the other of the two developes, that is, $i' = 0$, and the reasoning seems correct as far as it goes, but it was not shown how the demonstration would (as it ought to do) fail in the case of a surface having a double or cuspidal curve. I showed also that in the case where the common tangent plane is a stationary plane of the spinode develope (that is for the planes β'), the spinode curve and the node-couple curve touch instead of simply intersecting, it would seem that the tangent plane at such point is to be counted once, and not twice, in reckoning the number β' of such tangent planes; the like remark applies, of course, also to the points of intersection β of the double and cuspidal curves.

The Rev. Dr. Lloyd read a paper—

ON THE EFFECT OF A DISTANT LUMINARY, SUPPOSED MAGNETIC, UPON THE DIURNAL MOVEMENTS OF THE MAGNETIC-NEEDLE.

It has been usual to ascribe the ordinary diurnal variations of the magnetic needle to the influence of solar heat, either operating directly upon the magnetism of the earth, or generating thermo-electric currents in its crust. The credit of these hypotheses has been of late somewhat weakened by the discovery of a *lunar* diurnal variation in the three magnetic elements; while, at the same time, new laws of the *solar* diurnal change have been established, which are thought to be incompatible with the supposition of a thermic agency. There has been, accordingly, a tendency of late to recur to the hypothesis that the sun and moon are endued with magnetism, whether inherent or induced; and it is, therefore, of importance to investigate the effects which bodies, so constituted, would produce on a needle at the earth's surface, and to compare them with those observed. In the present communication the author has endeavoured to solve this question, on the supposition that the assumed magnetism of these luminaries is original and permanent. The results prove the insufficiency of the hypothesis to explain the phenomena.

We shall suppose, for simplicity, that the centre of the acting magnet is in the plane of the equator. So far as the diurnal change is concerned, we may suppose it to be fixed; accordingly, we may take that centre as the origin of co-ordinates, the line connecting it with the centre of the earth as the axis of x, and the plane of the equator as the plane of (xy). Then, if (x, y, z) be any point of the fixed magnet, μ the quantity of free magnetism contained in the element ds of the magnet at that point, m a magnetic element on the earth's surface, and (a, b, c) its co-ordinates, the force exerted by μ on m is

$$\frac{m\mu ds}{\rho^2};$$

in which ρ denotes the mutual distance of the points (a, b, c) and

(x, y, z). And the components of the total force exerted by the magnet on the magnetic element are

$$m\int\frac{(a-x)\mu ds}{\rho^3}, \qquad m\int\frac{(b-y)\mu ds}{\rho^3}, \qquad m\int\frac{(c-z)\mu ds}{\rho^3}.$$

The earth's radius and that of the luminary being small in comparison with their distance, the foregoing expressions are found to be reducible to

$$\frac{2mM\cos a}{D^3}, \qquad \frac{-mM\cos\beta}{D^3}, \qquad \frac{-mM\cos\gamma}{D^3};$$

in which D denotes the distance of the centre of the magnet from the centre of the earth, and a, β, γ the angles which its axis makes with the three axes of co-ordinates, and in which

$$M=\int\mu s ds,$$

the integral being taken between the limits $s=\pm l$, l being half the length of the acting magnet.

Now, in place of a single magnet, let there be an indefinite number, distributed in any manner throughout the acting magnetic body. Then, the radius of this body being small in comparison with its distance, the variations of D, both in magnitude and direction, may be neglected, and we have, for the three components of the acting forces,

$$X=\frac{2mP}{D^3}, \qquad Y=\frac{-mQ}{D^3}, \qquad Z=\frac{-mR}{D^3};$$

in which

$$P=\Sigma(M\cos\alpha), \qquad Q=\Sigma(M\cos\beta), \qquad R=\Sigma(M\cos\gamma).$$

In order to determine the effects of these forces upon a freely suspended horizontal magnet, they must be resolved into three others,—two of them in the plane which touches the earth at the point m (one in the meridian, and the other perpendicular to it), and the third in the direction of the earth's radius. The moment of the two former to turn the needle is equal to the moment of the earth's force by which it is opposed, or by $mU\Delta\delta\sin 1'$, in which U is the horizontal component of the earth's force, and δ the magnetic declination. We thus obtain an expression of the form,

$$\Delta\delta=\frac{1}{D^3U}(A+B\sin\theta+C\cos\theta);$$

in which A, B, and C are known functions of P, Q, R, and of the latitude and magnetic declination at the place of observation. Similar results are found for the changes of the two components of the terrestrial magnetic force.

From these results we learn that—

1. The effect of a distant magnetic body consists of two parts, one of which is *constant* throughout the day, while the other varies with the *hour-angle* of the luminary.

2. Each of these parts varies *inversely as the cube of the distance* of the luminary.

3. The variable part will give rise to a *diurnal inequality*, having one maximum and one minimum in the day, and subject to the condition—

$$\Delta_\theta + \Delta_{\pi+\theta} = 0.$$

This law does not hold with respect either to the solar or to the lunar diurnal variation.

Thus, in the solar diurnal variation of the declination, the changes of position of the magnet throughout the night are comparatively small, and do not correspond (as required by the foregoing law) to those which take place at the *homonymous* hours of the day. The phenomena of the lunar diurnal variation are even more opposed to the deduced law, the variation having *two maxima* and *two minima*, of nearly equal magnitude, in the twenty-four lunar hours, and its values at homonymous hours having, for the most part, the *same sign*. Hence the phenomena of the diurnal variation are not caused by the direct magnetic action of the sun and moon.

Mr. Henry Conybeare communicated a short notice of the works recently erected for the purpose of supplying the city of Bombay with water.

It was stated by Dr. Stokes that Mr. Groux, a gentleman having congenital fissure of the sternum, was at present in Dublin, and that the Academy would confer a great benefit on medical and anatomical science if they would appoint a commission to inquire into his case. It was then resolved that the Council be requested to consider the propriety of appointing a commission to examine and report on the case of Mr. Groux.

The Secretary announced the presentation by her Majesty's Government of a collection of 514 volumes of Statutes, Journals of the Houses of Parliament, London Gazettes, and Newspapers, as a donation to the Library of the Academy.

Resolved,—That the thanks of the Academy be presented to Colonel Larcom, by whom this large donation to the Library has been made to the Academy.

TUESDAY, MARCH 16, 1858.

James Henthorn Todd, D.D., President, in the Chair.

The Secretary of the Council read the following Report from the Council:—

REPORT.

In presenting their Annual Report for the Session of 1857–58, the Council regret that they cannot congratulate the Academy on any large publication of Transactions during the past year,—in fact, that department of our printing has been during that period wholly suspended. The cause of this is to be found not in any diminution of intellectual activity on the part of our members, but in the state of the finances of the Academy, combined with the fact that during the past year we have undertaken, and partly completed, the work of forming and publishing a Catalogue of our Museum. The very large expense which has attended the publication of the Part now in the hands of members has left us no available surplus which might be devoted to the publication of "Transactions." The whole of this subject has been carefully considered by the Council, who are clearly of opinion that a permanent or even lengthened suspension of the publication of our Transactions would be fatal to the interests of the Academy.

In order, then, to provide for the immediate resumption of this important work, the Council have arrived at certain Resolutions, which will be laid before you on this evening. Should you agree to the recommendations contained in those Resolutions, the Council think that the publication of our Transactions may be at once resumed, and hope that no further interruption will occur in this work, which is undoubtedly the most important function of the Academy. The present state of the unpublished portion of our "Transactions" is as follows:—

In Science, we have printed papers by Lieutenant Rennie, Professor Downing, Mr. Salmon, and Mr. Forster.

In Polite Literature, by Dr. Hincks and Dr. Wills.

In Antiquities, by the President.

The amount of matter thus printed, but not published, is:—In Science, 64 pages; in Polite Literature, 48 pages; in Antiquities, 58 pages. Total, 160 pages.

There has been some diminution in the number of papers read before the Academy during the past Session, as compared with that of 1856–57. Still, we have had some communications of much interest. In Mathematics, we have had papers from Sir William R. Hamilton, John T. Graves, Esq., A. Cayley, Esq., and Rev. Robert Carmichael; in the Sciences of Observation and Experiment, from Dr. Lloyd, Dr. Robinson, Professor Hennessy, Dr. Kelly, G. J. Stoney, Esq., and M. Donovan, Esq.; in Polite Literature, from J. Huband Smith, Esq., Dr. Hincks, and Dr. Ingram; in Antiquities, from the President and Dr. Reeves.

The subject of the "Museum Catalogue" has been before alluded to.

The first Part is already published, and it has been resolved to devote the proceeds of the sale of that Part to the publication of a second, in the preparation of which much progress has been made. As there are no other funds available for that purpose, it now rests mainly with the members of the Academy to decide whether this important work shall be completed, or whether it shall be allowed to remain imperfect.

The Council have to observe that, prior to March, 1857, the Academy had a very large and valuable collection of Antiquities, perhaps the largest national collection in Europe except that in Copenhagen; but we had no classified or arranged Museum; neither were the architectural details of the building at all adequate to the preservation or display of our national treasures.

In this position, and in order to meet the circumstances of the visit of the British Association to Dublin, Mr. Wilde undertook the arrangement, classification, and cataloguing of the Museum gratuitously, and with the result the Academy is acquainted. The Board of Works expended a sum of about £400 in completing the glass-cases, improving the roof so as to admit sufficient light, making an additional fire-proof safe, painting and decorating the Museum. The Board of Works also built (at the top of the house) a photographic gallery, as originally proposed some years ago.

The Collection, independent of gold and silver ornaments, coins, medals, and ecclesiastical antiquities, has been arranged, and a Catalogue of about 2800 articles has been published; the remaining articles are now in process of being catalogued, and Mr. Wilde hopes to have that part completed and made ready for the press during the summer vacation.

For the concluding part of the Catalogue 140 illustrations have been drawn on wood, and 102 engraved and paid for. The MS. Catalogue is now in process of completion, irrespective of any cost to the Academy, out of the price of Part I., which it is expected will also pay for the completion of the illustrations, provided the members who have not already subscribed will do so. Thus, in process of time, should the Academy be in funds, and inclined to complete the history of the collection, it will only have to pay for the printing and paper.

During the past year we have lost twelve members by death:—

Robert Ball, LL.D.; elected 23rd February, 1834.
Admiral Sir Francis Beaufort; elected 22nd October, 1832.
Thomas Clarke, Esq.; elected 30th November, 1853.
Edmund Davy, Esq., F.R.S.; elected 22nd October, 1827.
Charles Doyne, Esq.; elected 26th May, 1834.
Edmund Getty, Esq.; elected 13th January, 1845.
William T. Lloyd, Esq.; elected 13th January, 1840.
Nicholas P. O'Gorman, Esq.; elected 10th February, 1845.
Michael M. O'Grady, M.D.; elected 23rd May, 1846.
Miles John O'Reilly, Esq.; elected 25th February, 1833.
Thomas Weaver, Esq., F.R.S.; elected 29th January, 1816.
Thomas Wilson, Esq.; elected 12th April, 1841.

One illustrious name has been removed by death from the list of our Honorary Members. The Academy needs not to be informed how great a loss the scientific world has sustained in the death of M. Cauchy.

Thirty-one members have been elected since the last annual meeting. Their names are :—

James Cleland, Esq.
Captain George A. Leach, R.E.
Denis Florence Mac Carthy, Esq.
William Moore, M.D.
James H. Sawyer, M.D.
James A. Lawson, Q.C., LL.D.
Daniel G. Griott, Q.C.
Captain Charles Preston Molony.
Thomas O'Hagan, Q.C.
Bindon Blood Stoney, C.E.
James Whitehead, M.D.
Lord Stuart de Decies.
Lord Massareene and Ferrard.
Right Hon. Richard Atkinson, Lord Mayor of Dublin.
Denis Crofton, Esq.
Robert Corbet, Esq.
Samuel A. Cusack, Esq.
George Victor Du Noyer, Esq.
Alfred Furlong, Esq.
Henry Grattan, Esq.
Thomas Hayden, Esq.
George Paul Helsham, LL.D.
Rev. Alfred T. Lee, M.A.
Major-General Sir Chas. O'Donnell.
William K. Sullivan, Esq.
E. Percival Wright, M.B.
Alexander T. Blakely, Esq.
Maurice Henry Collis, M.B.
Howard B. Montgomery, M.D.
John Purser, Jun., Esq.
Samuel L. Hardy, Esq., M.D.

The Report having been amended, at the suggestion of Dr. Petrie and others, by the omission of a clause in which it was stated that the Museum of Copenhagen "was completed before ours was commenced,"—

It was Resolved,—That the Report of the Council be adopted.

The Ballots for the annual election of President, Council, and Officers having been scrutinized in the face of the Academy, the President reported that the following gentlemen had been duly elected :—

President.—James H. Todd, D.D.

Committee of Science.—Sir Robert Kane, M.D.; Rev. Humphrey Lloyd, D.D.; Rev. George Salmon, M.A.; Rev. Samuel Haughton, M.A.; William H. Harvey, M.D.; Rev. J. H. Jellett, M.A.; James Apjohn, M.D.

Committee of Polite Literature.—Rev. W. H. Drummond, D.D.; Rev. Charles Graves, D.D.; John Kells Ingram, LL.D.; John O'Donovan, LL.D.; Rev. Samuel Butcher, D.D.; John F. Waller, LL.D.

Committee of Antiquities.—George Petrie, LL.D.; William R. Wilde, Esq.; Joseph Huband Smith, M.A.; Charles Haliday, Esq.; John T. Gilbert, Esq.; Rev. William Reeves, D.D.; Lord Talbot de Malahide.

Treasurer.—Rev. Joseph Carson, D.D.

Secretary to the Academy.—Rev. Charles Graves, D.D.

Secretary to the Council.—Rev. John H. Jellett, M.A.

Secretary of Foreign Correspondence.—W. R. Wilde, Esq.

Librarian.—Rev. William H. Drummond, D.D.

Clerk, Assistant Librarian, and Curator of the Museum.—Mr. Edward Clibborn.

The President nominated, under his hand and seal, the following Vice-Presidents:—Rev. Humphrey Lloyd, D.D., Rev. William Reeves, D.D., Rev. George Salmon, M.A., John Kells Ingram, LL.D.

It was Resolved, on the recommendation of the Council:—

1. That the regular publication of our Transactions is absolutely essential to the welfare of the Academy.

2. That, in order to enable the Council to carry on this important work without interruption, it be recommended to the Academy to suspend, for the present, the Annual Grants of £100, each, to the Library and Museum, there being no other funds available for the purpose.

3. That the amount of the Grants annually voted to the increase of the Library and Museum be regulated by the funds in hands, after paying for the publication of the Transactions.

An Address to His Excellency the Lord Lieutenant, on his return to Ireland, was read and adopted.

DUBLIN UNIVERSITY ZOOLOGICAL AND BOTANICAL ASSOCIATION.

FRIDAY EVENING, JANUARY 15, 1858.

Professor W. H. Harvey, M. D., F. L. S., Vice-President, in the Chair.

The Minutes of last General Meeting having been read, were approved of, and signed by the Chairman.

The Rev. Eugene O'Meara read the following—

CATALOGUE OF DIATOMACEÆ COLLECTED IN POWERSCOURT, COUNTY OF WICKLOW.

The excursion of the Association of July 1857, may still be in the recollection of the Members. We assembled to an early breakfast, at the residences of our then Senior Vice-President (now our esteemed President), and of one of our Honorary Secretaries. Having done justice to the hospitality provided for us, we prepared for a drive of some ten or twelve miles ere the proper business of the day could begin. Headed by Professor Harvey, who took the lead of the botanists; Mr. Haliday, who reigned supreme among the entomologists; and Mr. Du Noyer, who kindly commanded the army of geologists,—we drove along the pretty mountain road that leads to the village of Enniskerry. The morning was all that could be desired: a clear blue sky above us faded off in the horizon into a pale white mist, that gave promise of a glorious day. Dublin Bay glittered beneath our feet, sparkling with the rays of a July sun. In about an hour we drove through the Scalp, one of the geological attractions of the county of Dublin, and in half an hour more we entered

the demesne of Lord Powerscourt. It would be foreign from my present purpose, even were I able, to tell of all the plants and insects that were collected in the course of the day. Dr. Harvey and Mr. Bain collected quantities of the pretty *Hymenophylum Wilsoni*. Dr. E. Percival Wright, and others, captured fine specimens of *Cossonus Tardii*, &c. It is to be wished that, on the occasion of this summer's excursions, the Members would return to the Hon. Secretaries a list of the various plants, &c., they may observe, and that then the Secretaries would form these materials into what, I cannot doubt, would be a most interesting paper. My own gatherings of Diatomaceæ were the most productive I have ever made; no less than sixty-six species figured by Smith having been found.

The following is a list of the species :—

Amphora ovalis.
,, minutissima.
Amphipleura pellucida.
Achnanthidium microcephalum.
,, lanceolatum.
Cocconeis pediculus.
Cyclotella Kutzingiana.
Campylodiscus costatus.
,, spiralis.
Cocconema lanceolatum.
,, cymbiforme.
,, parvum.
Cymatopleura elliptica.
,, apiculata.
,, solea.
Denticula tenuis.
Diatoma vulgare.
Epithemia granulata.
,, gibba.
,, turgida.
,, rupestris.
Fragillaria capucina.
Gonphonema dichotomum.
,, acuminatum.
,, intricatum.
Himantidium pectinale.
,, gracile.
,, undulatum.
,, soleirolii.
Melosira varians.
Meridion circulare.
Navicula ovalis.
,, crassinervia.
Navicula gibberula.
,, dicephala.
,, tumida.
,, rhomboides.
,, producta.
Nitzchia sigmoidea.
,, tenuis.
,, linearis.
,, minutissima.
Odontidium mesodon.
,, tebullaria.
,, parasiticum.
Pleurosigma attenuatum.
Pinnularia viridis.
,, major.
,, mesolepta.
,, radiosa.
,, oblonga.
,, tabellaria.
Surirella ovalis.
,, splendida.
,, pinnata.
,, biseriata.
,, angusta.
,, minuta.
Synedra radians.
,, lunaris.
Stauroneis gracilis.
,, phenicenteron.
,, anceps.
,, linearis.
Tabellaria floculosa.
,, fenestrata.

Dr. Harvey, V. P., read some "Notes on a new form of *Fibro-cellular tissue*, observed in an Alga from the Reef of Florida."

Professor R. W. Smith exhibited some curious varieties of some of our native ferns.

Mr. Burchal exhibited a fine collection of *Alpine Lepidoptera*, and made observations on some of the rarer species.

Mr. Bailey exhibited some rare Coleoptera taken in the Crimea and Africa. The thanks of the Members were voted to Mr. Bailey for exhibiting these insects.

The Members then proceeded to ballot, Dr. Beauchamp being appointed Scrutineer, when the following were declared duly elected:—

1. T. M. Dolan, Sen. Soph. 2. A. H. Hamilton, Sen. Fresh. 3. Robert J. Montgomery, M. A., Assist. Sec., Royal Zoological Gardens. 4. J. H. Nicholson, M. A. 5. E. J. Swift, Jun. Fresh.

Charles Spence Bate, F. L. S., having been proposed at the last General Meeting, and approved of by the Council, was then elected a Corresponding Member. By the wish of the Members present, the usual ballot was dispensed with, and Mr. C. Spence Bate was elected by acclamation.

FRIDAY EVENING, FEBRUARY 19, 1858.

Professor W. H. Harvey, M. D., F. L. S., Vice-President, in the Chair.

Minutes of former Meeting having been read, were approved of, and signed by the Chairman.

Letters were read from C. Spence Bate, F. L. S., and J. S. Bowerbank, F. R. S., acknowledging their election as Corresponding Members of the Association, and conveying their best thanks to the Members for the honour conferred upon them.

Rev. Joseph Greene read a paper by Lieutenant Crozier, R. E., A. B., Corresponding Member, being—

A CATALOGUE OF LEPIDOPTERA CAPTURED BY HIM DURING THE PAST SUMMER NEAR CHATHAM.

In the few remarks I intend to make, I shall confine myself to the Rhopalocera, Sphinges, and Bombyces, as in the course of a single summer it is impossible to arrive at anything like a correct estimate of the number of species of the Noctuæ occurring in a locality.

Chatham is situated on the chalk, and therefore a very favourable locality for meeting with many local species, as the results of my collecting expeditions proved.

My principal hunting-grounds were some oak woods, called Chattington Roughs, belonging to the Earl of Darnley. The undergrowth is very thick, but the woods are traversed by wide paths, and in many places there are large clearings, caused by the undergrowth being cut

down for hop-poles. These clearings abounded with Cratægi, Sibylla, W. album, and other species. The soil consists of a damp, tenacious clay, so as apparently to be quite unfit for the transformation of larva in it. This may account for the fact of my never having found any pupæ in the neighbourhood of Chatham, although I tried to be persevering in the search for them.

I shall now proceed to enumerate the species that I met with, omitting the very common species which occur everywhere.

Rhopalocera.

Papilio machaon.—A specimen was taken by Mr. Channy on the top of a chalk hill. Towards the close of the summer I saw it, and it was in fine condition. How could it have strayed so far from its haunts?

Gonepteryx rhamni.—Abundant.

Colias edusa.—I had the pleasure of seeing, but did not capture, this insect.

Colias hyale.—I took a fine pair in a clover field on the side of a precipitous chalk hill.

Aporia cratægi.—This fine insect is pretty abundant in the woods in the beginning of June, but from the strength and rapidity of their flight, they are difficult to capture. (I took about twenty.)

Leucophasia sinapis.—This insect I did not take myself, but have seen specimens captured in the neighbourhood.

Arge galathea.—Very abundant, but local.

Hipparchia semele.—One or two specimens in the same field as *C. hyale*.

Limenitis Sibylla.—This beautiful species occurred in considerable numbers along the edges of a clearing, which was almost the only place I met with them. It is really delightful to watch their graceful easy flight, as they float about on the bright sunshine of a summer's day. Does the larva ever feed on the sallow, as nearly all the specimens I captured were at rest on stunted bushes of that tree, and I could only find one small plant of honeysuckle in the immediate neighbourhood?

Apatura iris.—This magnificent species occurred in large numbers on the top of a hill, wooded with lofty oaks. I only succeeded in capturing three, as I did not possess an "Emperor" net, and was not aware at the time of the efficacy of putrid animal remains as a bait for his majesty. To obtain the specimen I did, I had to extemporize a net by fastening the one I carried in my hand to the end of a long sapling. This, however, formed a very unwieldy weapon, as the result showed.

Cynthia cardui.—Occurs generally. I did not meet with it.

Vanessa polychloros.—Abundant; but very hard to capture. I met with hybernating specimens in the spring, much more frequently, however, than the insect fresh from the pupa, in the autumn.

Argynnis Lathonia.—On the 23rd August, 1857, as I was walking along a grassy path in Chattington woods, not expecting to meet with anything new, suddenly something like a ray of golden light flitted past; I made a stroke at it with my net, and succeeded in getting it within its folds; and fancy my delight when, on taking it out, I found it to be a specimen of this beautiful species, in the most perfect condition. Later in the day I took another specimen, also fresh from the chrysalis.

A. selene.—Only one specimen.

A. Euphrosyne.—In great abundance.

Melitæa Athalia.—This extremely local species occurred in one or two spots. They seem to have a curious habit of changing their metropolis every year, as I was shown a spot which swarmed with them in 1856, but where only a few stragglers were to be seen when I visited it.

Thecla W. album.—This rather scarce species abounded in the same clearing as Sibylla. I generally captured them at rest on the sallow bushes, or on the blossoms of the privet. I remarked they never appeared in any numbers until after 3 P. M.

T. quercus.—Very abundant on the same oaks as Iris, on which it seems to attend.

Polyommatus argiolus.—Rather rare.

P. alsus.—Common, but local.

P. Corydon.—Very abundant on the chalk hills.

P. Adonis.—Moderately abundant.

P. agestis.—Rather rare.

Thanaos alveolus.—Very common.

T. tages.—Common in many places.

Pamphila linea.—Common.

P. sylvanus.—Very abundant.

SPHINGES.

Procris statices.—I met with a few specimens in one meadow.

Anthrocera trifolii.—Very abundant. Many curious varieties occurred, in some of which the colouring was quite different from the ordinary tint.

A. filipendulæ.—As common as it usually is.

Smerinthus populi.—Occurred at light.

Sphinx ligustri.—Common in the larva state. I only obtained one specimen of the perfect insect.

Macroglossa stellatarum.—Only saw one specimen, as I did not visit the haunts of the species.

Trochilium culiciformis.—One specimen.

T. tipuliformis.—Occurs sparingly.

BOMBYCES.

Hepialus hectus.—Common in the grassy lanes of one wood.

H. lupulinus.—Very common.

H. humuli.—I only met with one specimen (a female) of this very common species.
H. vellida.—Occurs in some plenty.
H. sylvinus.—I took one or two specimens of this, the prettiest of the Hepialidæ, as they were flying rapidly along the hedge.
Ptilodontis palpina.—Three or four specimens occurred.
Diloba cæruleocephala.—Very abundant as larva.
Orgyia pudibunda.—Common as larva, and the perfect insect comes to light.
Liparis salicis.—Excessively abundant on a row of poplars, on Chatham Lines.
P. auriflua.—Very abundant.
Lithosia aureola.—Scarce. I took two specimens about the end of May or beginning of June, although the time usually given is much later.
L. egrisola.—Scarce. One specimen by beating.
L. mesomella.—Scarce. Two specimens by beating.
L. quadra.—Scarce.
L. minuta.—Scarce. One specimen came to light.
Euthemonia russula.—Rather rare. Occurs in the clearings of the woods.
E. plantaganis.—Excessively abundant, but local. One afternoon in May I captured a great many after 5 P.M.; before that, I had only seen one or two.
Arctia villica.—Rather scarce.
Eriogaster lanestris.—I found one colony of the larva of this insect on blackthorn. They spin a very thick, tough web.
Clisiocampa castrensis.—I succeeded in breeding about 120 specimens of this local species. The larva I found on the muddy banks of the Medway, feeding on a Polygona (*Robertii* is, I believe, the species). When young they are gregarious, and live in a large web; after moulting they separate, and finally spin up amongst the roots of the grass, or between two leaves of the Polygona. It is very hard to find the cocoon, although the larva are so numerous and conspicuous.

C. castrensis seems to be very lazy in constructing its cocoon, as, on two or three occasions, several united their efforts to construct a large one, in which the Chrysalides were placed without any intervening web.

Odonestis potatoria.—Very plentiful as larva.
Cilix spinula.—Several specimens occurred.
Platypteryx lacertula.—Only one specimen.
P. hamula.—I obtained one specimen at a gas lamp.

MR. DAVID MOORE, M. R. I. A., A. L. S., Curator of the Royal Dublin Society's Botanic Gardens, read a paper—

ON THE OCCURRENCE OF A SINGULARLY METAMORPHOSED STATE OF BRYUM SANGUINEUM; AND ON THE DISCOVERY OF SOME ADDITIONAL SPECIES TO THE IRISH FLORA.

It is now a received axiom among botanists, that it is by studying the morphological changes which from time to time take place with phænogamic plants, that their true structure can be fully understood. This, no doubt, holds good also to a certain extent with cryptogamic plants, but, owing to the simplicity of their structure, it is rarely that opportunities are afforded for observing such changes of parts, with the exception of Ferns, some of which natural group do occasionally assume appearances differing greatly from their normal state. The Mosses are, however, so constant to their general forms, that they have been likened by some to watch-works among vegetables, in consequence of the regularity and fineness of their structure; any abnormal changes, therefore, found to occur among members of this tribe are the more worthy of being recorded.

In the present instance I have to bring under the notice of this Association a remarkable state of *Bryum sanguineum,* which is so altered in some of its parts as to render it unlike the typical state of the plant. In the normal form of this species the lids of the capsules are shortly apiculate, i. e. they have short points, whereas the changed states here exhibited have long rostrate beaks, nearly equalling the length of the capsules themselves. Besides, these beaks are swollen at their bases in such a manner as to appear as if considerable progress were made in the formation of a second capsule, articulating with the first; and in one specimen there is no lid whatever, but a gradual tapering of the apparent capsule from the base to the long-pointed apex. The whole plant is more or less altered, the leaves being narrower and more lanceolate than they usually are; and in one case two of the setæ were observed joined together nearly their whole length, when they separated towards their apices, each ending in a regular capsule. Mr. Wilson, to whom I sent specimens of this monstrosity, considers that the change arises from a morbid incorporation of the calyptra with the operculum when in an early state of inflorescence. This I also believe to be the principal cause, though it will not fully account for the plant which has no operculum. The specimens here presented were found growing among a large patch of the species in its normal state on Howth, by Mr. D. Orr, in April, 1856.

The following species of Mosses, not hitherto recorded as Irish, have been discovered and identified since I furnished the last supplementary list in the "Journal of the Royal Dublin Society" (*vide* vol. i., 1857).

Sphagnum contortum (*Schultz*). Black-stemmed Bog Moss.

Habitat: Wicklow Mountains; Mr. J. H. Davies, of Thirsk, Yorkshire, who appears to have been the first to recognise this species in Ireland, and who lately sent specimens to me gathered in Wicklow. The plant, however, is not rare, since I find it in my herbarium, col-

lected from bogs in the North of Ireland twenty years ago; and Mr. D. Orr has it from the Three-Rock Mountain, Co. Dublin, and also from Howth, as well as the variety γ. *obesum* from the latter place.

Grimmia Schultzii (*Bridel*). Schultz's Grimmia.

Habitat: on granite rocks near the Scalp, Co. Dublin, July, 1854; Mr. D. Orr. This plant we had for some years considered to be only *Grimmia tricophylla*, to which species it bears strong resemblance; but some doubt having arisen on the matter, specimens were submitted to Mr. Wilson, who at once pronounced it his *G. Schultzii*.

Orthotrichum Lyellii (*Hooker*). Mr. Lyell's Bristle Moss.

Habitat: on trees near Clonmel, and at Powerscourt. This interesting addition to our Flora was first discovered by me growing on trees by the side of the River Suir, near Clonmel, bearing fruit in July, 1856, and since barren at Powerscourt.

Bryum warneum (*Blandow*). Warren Thread-Moss.

Habitat: on muddy spots at the North Bull, near Dublin, 1857; Mr. D. Orr. This species is described at page 12, "Bryologia Britannica," among the addenda. At the time of the publication of that work only two habitats appear to have been known for this moss in Britain; one in Fifeshire, Scotland, and the other in Lancashire; the discovery of it in Ireland is, therefore, the more interesting.

Bryum inclinatum (*Br. and Sch.*). Small-mouthed Thread-Moss.

Habitat: this species came up in considerable quantities among heath mould brought from the Dublin Mountains, in one of the conservatories at the Botanic Garden in 1856, and has since been collected on a wall at Howth, by Mr. D.Orr. Probably not rare.

Bryum cernuum (*Hedw.*). Drooping Thread-Moss.

Habitat: on the wall which surrounds the viceregal demesne, Phœnix Park, 1856; Mr. D. Orr. And since, in other localities near Dublin.

Hypnum salebrosum (*Hoffman*). Smooth-stalked Streaky Feather Moss.

Habitat: on a grassy sand-bank by the side of the River Tolka, near the Botanic Garden, Glasnevin, 1857; Mr. D. Orr.

The following species have either been considered of rare occurrence in Ireland, or have had no certain localities mentioned in "Bryologia Britannica":—

Sphagnum rubellum (*Wilson*). Red Dwarf Bog Moss.

Habitat: near the base of Carntuel Mountain, Killarney, June, 1857, growing with *Jungermannia Woodsii* and *J. juniperina*.

Orthotrichum phyllanthum (*Br. and Schemfer*).

Now found to be a most abundant species in Ireland, though always barren.

Orthotrichum tenellum (*Bruch*).

Lately found by Mr. D. Orr, on birch trees near the head of Ballini-scorney Glen, county of Dublin. The other habitats known for this plant are in the counties of Kerry and Galway.

Bryum torquescens (*Br. and Sch.*)

This beautiful moss has been found to grow in considerable abundance on the tops of walls near Abbotstown, county of Dublin, by Mr. D. Orr. Probably not rare in Ireland.

Hypnum glareosum (*Bruch*).

One of the commonest mosses near Dublin, though only one solitary habitat is given for it in "Flora Hibernica," in Lough Bray.

Mr. John Bain, Curator, College Botanic Gardens, exhibited a very beautiful variety of an *Athyrium* —— (?) discovered by a lady in the county of Wicklow.

Mr. D. Moore exhibited a series of *Hylurgus piniperda*, from the Botanic Gardens of the Royal Dublin Society, at which place they were very destructive to the pines.

The Members then proceeded to ballot, Dr. Daniel acting as Scrutineer, when J. T. Banks, M. D., was declared duly elected.

FRIDAY EVENING, MARCH 19, 1858.

Professor W. H. Harvey, M.D., F.L.S., Vice-President, in the Chair.

Minutes of former Meeting having been read, were approved of, and signed by the Chairman.

Professor J. Reay Greene read the following paper:—

ON THE GENUS LUCERNARIA.

The genus Lucernaria was founded by O. F. Muller for the reception of certain marine zoophytic forms supposed to be nearly related to Actinia. All the species which it includes are of a gelatinous consistence, and more or less campanulate in form, having the narrow extremity of the body attached to the submarine objects by means of an adherent disc, while the opposite (or erect) aspect is surrounded by numerous short tentacula arranged in tufts round the margin of a saucer-like cavity, in the centre of which the mouth is situated.

Five species have been recorded as inhabiting the shores of Britain, viz.:—

1st. *L. auricula.*—This species is provided with eight tufts of tentacula, placed at equal distances from one another, and having a marginal tubercle between each pair. The adherent disc is situated at the extremity of a short peduncle. The colour is exceedingly variable.

2nd. *L. campanulata.*—The arrangement and number of the tentacular tufts is the same as in *L. auricula*, but the tentacula in each of them are more numerous, and the marginal tubercles are absent. The adherent disc is separated from the body by a cleft or stricture. The colour is greenish-brown.

3rd. *L. fascicularis*, which has the margin surrounded by eight tentacular tufts *arranged in pairs*. The peduncle is long and wrinkled, terminating in a narrow adherent base. The colour is dark-brown.

4th. *L. cyathiformis.*—In this well-marked species the body is goblet-shaped, and the tentacular tufts are placed round the *interior* of the margin over which they slightly project. In the four remaining British species they occupy the extremities of the produced marginal lobes. The peduncle is corrugated, and of equal length with the body. Its extremity is dilated into a flat adherent disc. Its colour is greenish or dusky brown.

5th. *L. inauriculata*, which differs from *L. fascicularis* in having the eight tentaculiferous lobes equidistant from each other; from *L. auricula*, in the absence of any ear-like appendage at the middle of the border of the connecting webs between these lobes; from *L. campanulata* in the absence of the "two series of foliaceous processes arranged on each side of a white line," extending from the sides of the mouth along the middle of each connecting web; and from *L. cyathiformis* in the tentacles being supported in clusters, at the extremity of lobes produced beyond the margin of the infundibular disc.

Some add a sixth British species, *L. quadricornis*, but this is usually considered to be a variety of *L. fascicularis*.

The five forms above briefly described have been always viewed in the light of distinct species, and I am not aware that any naturalist has ever questioned the propriety of so regarding them. But the examination of a form of this genus which I obtained in February of the present year, at Haulbowline, county of Cork, has led me to entertain a different opinion.

The Lucernaria to which I allude was one-third of an inch in length, and of a delicate pink tint similar to that seen in some specimens of *L. auricula*. In shape and general appearance it bore some resemblance to *L. fascicularis*, but the form of the body was fuller, and more cup-shaped. It was furnished, like that species, with a long peduncle, but the latter was destitute of corrugations, and dilated at its extremity into an adherent disc, in both characters differing from the peduncle of *L. fascicularis*. The margin was surrounded by eight tufts of tentaculæ arranged in pairs, but this arrangement was by no means so well marked as in the last-mentioned species—the tufts, at the first view, appearing to be almost equi-distant. Between each of the pairs a marginal tubercle occurred. In other respects the oral aspect was not unlike

that of *L. campanulata*. Foliaceous processes proceeded from the mouth to the spurs between the arms as in that form. The stomach also was provided with peculiar worm-like cæcal appendages, in all respects similar to the same organs in *L. campanulata*.

The writhing movement of detached portions of these appendages continued for a considerable time. (*Vide* Dr. Johnston's "Brit. Zoophytes," second edition, p. 249). It is evident that the Lucernaria here described differs from any other British species, and at the same time exhibits characters which connect it with three of these. In colour, and in the possession of marginal tubercles, it corresponds with *L. auricula*, but it differs from that species in the form of its body, and the appearance of its oral aspect. In the first of these characters it is similar to *L. fascicularis*, but it differs from that form in its smooth peduncle and adherent disc, as also in oral aspect. In this last point of view it is akin to *L. campanulata*, but from this it differs in possessing marginal tubercles, and in having the tentacular bulbs arranged in pairs. It might, then, be inferred that it was a distinct species; and if we admit the specific distinctions of *L. auricula*, *L. campanulata*, and *L. fascicularis*, we must also admit that of the species described. But it appears to me to be far more advisable to regard these as varieties of one and the same species, which I propose to name *L. typica*. The specific differences between these three forms are by no means strongly marked. Some naturalists assert that they have seen examples of *L. auricula* in which the marginal tubercles are absent; and yet these are regarded as its chief distinguishing characteristics. Again, the variation to which the same species is liable, even in so limited a district as the British Isles, from changes of aspect, light, and temperature, is far from being fully recognised. This is true, especially in the case of Zoophytes, for it is well known that in some instances Dr. Johnston's descriptions of many of these last have been found insufficient, simply because they were those of the varieties of these species found on the shores of the eastern borders. The example of Lucernaria which I have obtained is probably young, since its length is not more than one-third of that which many Lucernaria attain, and is on this account well adapted to show the *general* characters of the species. I do not even, notwithstanding its peculiar characters, consider it a variety. It is merely an immature form of that one species which, under different circumstances, might become *L. auricula, L. campanulata, or L. fascicularis*. The last-mentioned species occurs in but two (or three) British localities. The peculiar form probably depends upon local causes. The *L. cyathiformis* is, however, a distinct form.

With regard to the position of the genus Lucernaria, the majority of writers seem to be in error. It is usual to place this genus in the neighbourhood of Actinia, and to state that the habits of the Lucernaria are intermediate between those of Medusæ and Sea-Anemones. Mr. Gosse considers that this genus is the link which connects the normal Actinia with the Medusæ. How any forms can do this, it is not easy to understand. The Medusæ and Actinia belong to separate and distinct divisions of the

extensive sub-kingdom, Cœlenterata. These two classes are the Hydrozoa and the Actinozoa. That the Lucernaria is to be placed in the latter seems more than doubtful. Those who associate it with the Actinia do not appear to be at all familiar with its anatomy. More wisely, we think, has Mr. Huxley placed it among the Hydrozoa, and made it the type of an extensive family, containing the *Hydra tuba,* and such of the discoid Medusæ whose direct development from ova seems established, e. g., Eginopsis. Such appears to be its true position.

Dr. E. Percival Wright did not coincide with Professor J. Reay Greene's reasons for supposing the identity of the three mentioned species of Lucernaria; nor did he think that by allowing their specific distinctness he acknowledged that of the young form described.

Dr. E. Percival Wright, Director of the University Museum, stated that for the last few months he had been engaged in arranging the collections made by Professor Harvey in Australia, Tasmania, New Zealand, and Fiji. It would, of course, be a work of some years before the whole of these collections could be classified and named; but Mr. Bowerbank had kindly undertaken the Sponges; Professor Kinahan the Crustacea; Professor J. Reay Greene the Echinoderms; Professor Wyville Thomson the Hydroid Zoophytes and the Polyzoa; while he intended to devote himself more especially to the Shells. From time to time papers on portions of these subjects would be submitted to the Association, and all new species would be illustrated by figures. The first contribution he had much pleasure in bringing before the Members this evening, namely, that of Professor Wyville Thomson—

ON NEW GENERA AND SPECIES OF POLYZOA IN THE COLLECTION OF PROFESSOR W. H. HARVEY, OF TRINITY COLLEGE, DUBLIN (WITH FIVE PLATES).

Part I.

Dr. Harvey has kindly given me an opportunity of examining a quantity of Marine Polyzoa and Hydroid Zoophytes, principally the "refuse" of the magnificent series of Algæ lately collected by him on the southern and western coasts of Australia. Though occupying this undignified position, the collection of Zoophytes is an extremely valuable one, the largest probably, with one exception, that of the energetic "Rattlesnake" naturalists, which has ever been brought to Europe from the Australian seas.

This first communication consists of an enumeration of the species belonging to the first six families of the Cheilostomatous sub-order of Polyzoa.

I have few authorities to quote and to acknowledge. Mr. Busk's admirable Catalogue of the Polyzoa in the British Museum has been my guide throughout. I have almost entirely adopted his arrangement, with full concurrence in his views of grouping into families and genera. I take this opportunity of thanking him most sincerely for his volume, and still more for his friendly MSS., assistance, and counsel. Some ad-

ditional terms I have adopted from Dr. Allman's excellent "Memoir on the Fresh-water Polyzoa." As any accurate information with regard to the geographical distribution of these forms is of importance, I have incorporated with those collected by Dr. Harvey one or two smaller collections, sent to him with Algæ from various parts of the world. A series, lately procured by Dr. Joliffe in New Zealand, is very interesting.

I began an examination of foreign Polyzoa and Zoophytes in the hope of falling in with some clue to the affinities of some Palæozoic forms, and especially of the Graptolites. In this I have hitherto been disappointed. Although the Graptolites appear in some respects to approach the *Polyzoa ctenostomata,* they have still peculiarities which are apparently inconsistent with the structure and mode of growth of any living order.

In Dr. Harvey's collection the Cyclostomata and Ctenostomata are few in number. The Hydroid Zoophytes are very numerous, and most interesting. They are in progress of illustration.

The second part of this communication will conclude the Cheilostomata.

Class.—POLYZOA.

Order 1.—P. INFUNDIBULATA.
Sub-Order 1.—CHEILOSTOMATA.
Sect. 1.—Articulata.
Subsect. 1.—Uniserialaria.

Family 1.—Catenicellidæ (*Busk*).

Genus 1.—CATENICELLA (*Blainville*).

As usual in collections from the other side of the Equator, the Catenicellæ are prominent and abundant. Most of the species in the "Rattlesnake" collection are repeated, and seven undescribed forms occur. One new species belongs to the fenestrate division; the second differs so completely from every described form as scarcely to be referable to any of the formerly characterized groups, though occupying a position to a certain extent intermediate between the two first: four are vittate; and the seventh, though distinctly a Catenicella, and closely allied to *C. aurita* (*Busk*), simulates to a certain extent the structure of the remarkable genus Calpidium.

Some of the new forms throw some little additional light upon the structure and development of the cœnœcium. In *C. Harveyi* and in *C. alata,* the two membranes of which the cell wall is composed are remarkably distinct. In the former species particularly the outer layer seems scarcely to be in contact at any point with the inner, investing it like a loose horny sac. The large "avicularian processes" are open and cup-like, with ragged edges. In *C. alata* the two layers are also very distinct; but they are in contact over the greater part of the surface of the cell. In both species the upper spine or cup and the lower division of the lateral processes are formed of the outer membrane alone; while the true avicularian chambers, with the avicularia, are processes of the

inner layer, the true wall of the cell. Chambers formed of the outer film are often entirely open or irregularly perforated with large apertures.

The outer membrane seems to have something to do with the development of the cell. It is very possible that during the process of the extension of the cœnœcium by gemmation, the outer layer may form a dilatation expanding and filling with formative blastema, and that within this sac the true cell wall and the organs of the polypide may be subsequently specialized. In *C. Harveyi*, at a bifurcation, the young secondary cell is entirely invested by this membrane during its early development, and it remains permanently entire over the calyptriform ovicell, in both these cases looking like the natural continuation and "finish" of the abortive cup of the superior lateral process.

In all cases where a secondary cell is the result of a further lateral development of a primary cell, the former originates in the avicularian chamber and process of the latter. In *C. geminata* one lateral process of each axial cell is always developed into a secondary cell; very probably the avicularian chamber, with its processes, whatever their direct teleological object, may be the aborted indications of a constant tendency towards development in this direction.

Notwithstanding the numerous additions to the genus, Mr. Busk's original subdivisions retain their natural integrity. *C. alata* fraternizes with the typical Fenestratæ. Busk's specimen of *C. aurita* must have been poor. A good example differs so much from the Fenestrate group, and so closely approaches *C. geminata*, which could not possibly be associated with them, that it has been deemed advisable to put the two species provisionally at the end of the list, thus indicating the tendency of *C. geminata* towards the structure of the next genus.

C. Harveyi stands alone a representative of the "Fasciatæ;" the position of the ovicell is very characteristic.

The new "Vittatæ" are all normal. In this group there are two modifications of the ovicell: in the greater number it is galeriform and superior, encroaching on the cavity of the cell above it, which is sessile, by a broad base on the ovicelligerous one. Two, *C. taurina* and *C. perforata*, have a globular vesicle sessile on the older cell of a geminate pair.

a.—Catenicellæ fenestratæ (*Busk*).

1.—*C. lorica* (*Busk*).

A single fragment; Bass' Strait; Dr. Harvey.

2. *C. ventricosa* (*Busk*).

Abundant, Bass's Strait, Van Diemen's Land; Dr. Harvey. Port Fairy; James Dawson, Esq.

3.—*C. hastata* (*Busk*).

Bass's Strait; Dr. Harvey. New Zealand, abundant; Dr. Joliffe.

4.—*C. cribraria* (*Busk*).

One or two close short tufts, Bass's Strait; Dr. Harvey. Improbable as it may at first sight appear, I have some suspicion that this may be a stunted variety of the last. The extreme forms are very distinct, but I have a singular series of intermediate specimens.

5.—*C. alata, n. s.* Plate XIII., Figs. 2, 4.

Cells pyriform. Fenestræ 5–7.

Irregular grooves pass inwards from the fenestræ, giving the space within a somewhat granular appearance. Lateral processes enormous, consisting of a large hollow conical ascending process, with a pyriform opening in front, a nearly tubular "avicularian chamber" passing outwards opposite the upper third of the cell mouth, and ending in a minute avicularian; and a wide hollow fringe continued down to the base of the cell, and irregularly perforated in front. Ovicell (?).

The specimen figured is somewhat smaller and more delicate than usual. The cœnœcium does not appear to attain a great size. All the specimens in the collection are parasitical on other Polyzoa, and on red Algæ. Old specimens have often lost their large ascending processes, which gives them a very different appearance.

Bass's Strait; Dr. Harvey. Port Fairy; J. Dawson, Esq.

6.—*C. plagiostoma* (*Busk*).

Bass's Strait; Dr. Harvey. On Fucoids, abundant and fine.

7.—*C. margaritacea* (*Busk*).

Bass's Strait; Dr. Harvey. Port Fairy; James Dawson, Esq. New Zealand; Dr. Joliffe.

β.—Catenicellæ Fasciatæ (*Wyv. T.*).

8.—*C. Harveyi, n. s.* Plate X., Figs. 1, 2.

Cœnœcium forming loose, handsome, curling, brown tufts. Cells large, purely horny, vase-shaped; expanded superiorly by moderately large lateral processes, usually bearing large sublateral avicularia. External membrane thin, loosely investing the inner; and raised into conical papillæ on the front of the cell. Inner membrane strengthened by a raised strap of chitine, continuous with the thickened rim of the cell-mouth, dividing immediately below the lower lip, and forming a ring, again uniting and passing down the middle of the front of its cell to its base; and by similar straps spreading, apparently irregularly, over the avicularian processes, and over the back of the cell. Ovicell calyptriform; sessile by a broad base in the position of one of the avicularian processes of a cell, which it replaces. Back of ovicell furnished with a very large sessile avicularium.

Bass's Strait; Dr. Harvey. A single tuft. This is a remarkable and most distinct species. The cells are nearly as large as, and resemble in form, those of *C. amphora*.

The cell walls are very evidently formed of two membranes, which remain distinct.

In dried specimens the inner and stronger coat retains its form, while the outer appears to invest it in loose, wrinkled folds, expanding into an irregular projecting frill round the mouth. When the cœnœcium is boiled, to expel the air and expand the tissues, the water passes freely between the two layers, raising the outer wall into distinct papillæ, and showing it loosely hung round the cell.

The true avicularian chamber is a continuation of the inner cell-wall, but the hollow lateral processes, whether cups or spines, are formed of the thin outer membrane alone.

γ.—CATENICELLÆ VITTATÆ (*Busk*).

9.—*C. formosa* (*Busk*).

Van Diemen's Land; Dr. Harvey.

10.—*C. elegans* (*Busk*).

Bass's Strait; parasitical on Algæ and on other Polyzoa; abundant; Dr. Harvey.

11.—*C. Dawsoni, n. s.* Plate XI., Fig. 1.

Cells rounded, gibbous; lateral processes large, curved forwards and outwards, blunt, with usually a little depression, apparently an abortive avicularium at the apex. Cell-mouth rather small, rounded; operculum prominent. Surface of cell irregularly dotted with minute papillæ. Vittæ broad and short, sublateral near the base of the cell. Ovicell (?).

This species does not seem to attain a large size. There appear to be two varieties, a broader and a narrower, but agreeing in all essential characters.

The broad form occurs of a fine yellowish-brown colour, and in great beauty on Algæ from the Fremantle district, Western Australia (Harvey); and the narrower is abundant, of a cinereous gray, on Ballia sent from Port Fairy by James Dawson, Esq., of Kangatong, to whom I am indebted for many Australian rarities, and for much curious information.

12.—*C. castanea, n. s.* Plate XIII., Fig. 3.

Cells ovate, elongated. Superior lateral processes small and rounded; united above the cell aperture by a *smooth* prominent ridge; the lateral processes continued round the lower angles of the mouth, so as almost to form a corresponding ridge beneath.

Cell mouth small and round. Operculum very thick. Avicularia small, lateral; vittæ linear, lateral, extending nearly the whole length of the cell. Ovicell (?).

Cœnœcium forming graceful curling tufts. Cells of a rich chestnut hue, contrasting well with the bright red of the fibrous compound stem. Allied to *C. gibbosa* (*Busk*), which does not occur in the collection.

Bass's Strait; Dr. Harvey.

13.—*C. umbonata* (*Busk*).

Bass's Strait; Dr. Harvey.

14.—*C. crystallina, n. s.* Plate XIII., Fig. 1.

Cells subglobular, pyriform, fringed on either side by a wide hollow border, spreading upwards, outwards, and slightly forwards, into large lateral processes, frequently furnished with small lateral avicularia, seated in cup-like depressions.

Two arched markings, very constant in form, traverse this wide portion of the lateral process, which is continued downwards in a hollow fringe to the base of the cell.

Cell aperture large: rim slightly prominent. Vittæ long and well marked, sublateral, and extending nearly to the level of the lower lip. Front of cell studded with elevated papillæ, and whole surface ornamented with delicate diverging lines, which give the cœnœcium a beautiful glistening appearance. An elevated ridge runs down the middle of the back, the lateral portions falling off like the roof of a house, giving the transverse section of the cell a somewhat triangular outline. Ovicell unknown.

Parasitical in delicate glassy tufts on Polyzoa.

Bass's Strait; Dr. Harvey.

A very distinct and beautiful form. The arches in the hollow wings seem to be lines along whose course the membranes of which the opposite walls of the wings are composed are in contact. In the Vittatæ generally the double cell-wall is by no means so distinct as in the fenestrate group. There are, however, frequent indications that the structure is the same.

The vittæ seem to be rows of bead-like spaces between the layers.

15.—*C. Buskii, n. s.* Plate XI., Fig. 2.

Cells almost cylindrical, slightly contracted towards the truncated base. Connecting horny tube very short. Superior lateral avicularian processes represented by longer or shorter slightly retrocedent spines, or by open lacerated cups usually bearing small avicularia at the base. Spines longer in the newer cells towards the ends of the branches. Cell-mouth small and round. Vittæ linear, sub-lateral extending nearly the whole length of the cell. Front of cell slightly tubercular. Ovicell galeriform, superior; anterior surface slightly concave, bordered above by a projecting crescentic beaded rim; posterior surface convex, encroaching on the cavity of the next cell, against which it is cemented, and which is sessile on the ovicelligerous cell.

Probably allied in habit to *C. taurina* (*Busk*), as its resemblance to *Thuiaria thuia* is remarkable. Cœnœcium very calcareous.

Bass's Strait; abundant; Dr. Harvey.

16.—*C. perforata* (*Busk*).

Bass's Strait; abundant; Dr. Harvey.

The ovicell of this pretty species resembles that of *C. taurina* (*Busk*).

It is galeate, tuberculate, sessile on the apex of one of the cells of a geminate pair.

δ.—CATENICIELLÆ SIMPLICES (*Busk*).

17.—*C. carinata* (*Busk*).

New Zealand; Dr. Joliffe.

ε.—CATENICELLÆ AURITÆ (*Wyv. T.*)

18.—*C. aurita* (*Busk*).

Bass's Strait and Fremantle; Dr. Harvey. Port Fairy; J. Dawson, Esq. New Zealand; Dr. Joliffe.

Fine specimens have the front richly tuberculated. Three or four tubercles below the mouth are perforate; but there is no approach to the true fenestrate character.

19.—*C. geminata*, *n. s.* Plate X., Fig. 3, 4.

Axial cell geminate. The secondary cell developed alternately on either side of the axis. Axial cells pyriform; a large gaping avicularium on the angle opposite the secondary cell. Secondary cell giving off by a terminal horny tube a single wedge-shaped peripheral cell. Cell-mouth large; a deep notch in the centre of the lower lip. In the primary and secondary axial cells four or five blunt spines surround the upper margin of the mouth, which is surmounted in the peripheral cells by two longer ear-like processes. Front of cell tuberculated. Ovicell unknown.

A small species, apparently generally distributed in the Australian seas. Epiphytic on red Algæ.

Bass's Strait and Fremantle; Dr. Harvey. Port Fairy; Mr. Dawson. New Zealand; Mr. Joliffe.

Had it not been for its close resemblance to *C. aurita* (*Busk*), evidently a true Catenicella, and with which it often grows associated, one might have almost been inclined to consider this curious little form the type of a new generic group, or an aberrant species of the genus Calpidium. As in Calpidium, the cells have two "key-holes;" but a single glance must satisfy us that the cell consists of a primary and a secondary chamber, bearing the same relation to one another that the two cells of a geminate cell bear at a bifurcation in any of the other species of the genus. *C. geminata* bifurcates at every cell, so that all the axial cells are geminate. The septum between the cells is traced on the back of the cell by a deep groove in the usual position. The back of the primary cell, both in this species and in *C. aurita*, is frequently perforated to give origin to a horny, tubular tendril. The secondary cell sometimes gives off a secondary axis, but more usually only a single wedge-shaped cell, apparently partially abortive. The cœnœcium is very calcareous, and becomes very thick with age, a calcareous deposit obliterating all the markings. The horny connecting tubes between the cells are unusually long.

2.—Cothurnicella, *n. g.*

Cells in simple rows, each row arising from the side of a joint of an articulated stem, each cell springing from the upper and back part of another by a short horny tube. Cells all facing the same way.

Cell-mouth provided with a movable operculum. Ovicell an ordinary cell of a series, much enlarged, but scarcely modified in form.

C. dædala, n. s. Plate XI., Figs. 3 and 4.

The only known species.

This genus seems to have a sufficient number of characters in common with Catenicella to warrant its admission into the same family. It is, however, at once distinguished from the rest of the Catenicellidæ by its simple rows of cells arising regularly from the joints of an articulated stem. The joints of this stem appear to be abortive cells. The last joint of one branch is often dilated into a cell, while the other branch ends in a single or double tendril of narrow joints, and the final cell of a row is frequently capped by a similar tendril, representing a continuation of the series. In *C. dædala* the stem is at first simple, then makes a single bifurcation, and the cells start in straight rows, a row from the inner aspect of each joint of each branch, so that the triangular space within the fork is closely strung, like a harp, with parallel strings of cells (Plate XI., Fig. 3). The anterior aspect of the cell is narrow and slipper-shaped.

The mouth is placed near the top of the cell, large and crescentic, with a thin projecting upper rim. A movable semicircular operculum, with a raised edge, covers, or hangs below, the cell mouth. The operculum has at its base on either side a projecting triangular catch, which fits into a notch in the lip. One would almost expect this apparatus to shut with a snap like the clasp of a purse, it is so nicely fitted, and so eminently mechanical-looking.

Below the cell aperture a long, depressed area stretches nearly to the base of the cell. The cell is much compressed laterally; the side view is much broader, and almost reniform. The cell-wall is double throughout, with a wide space between the layers, thus forming two distinct chambers, the inner not even resembling the outer in form. The anterior depressed area is formed by the outer layer alone, so that beneath there is still another space before reaching the inner wall. In the centre of the area a tube passes through this space, uniting two corresponding apertures, one in either membrane, and thus communicating directly with the interior of the cell. The side view shows the inner chamber as a doubly bent expansion of the common tube of the cœnœcium.

Here and there one of the cells of a row is about double the size of the rest. These large cells have their opercula always closely shut. They are slightly more gibbous than the others, but scarcely differ from them in form. They are, doubtless, the ovicells.

The cœnœcium is small and delicate, very calcareous, with a beautiful pearly lustre. Parasitical on Fucoids.

Fremantle District, Western Australia (Dr. Harvey).

Subsect. 2.—Bi-Multiserialaria.

Family 2.—Salicornariadæ (*Busk*).

1.—Salicornaria (*Cuv.*).

1.—*S. tenuirostris* (*Busk*).

Bass's Strait; Dr. Harvey.

2.—Nellia (*Busk*).

1.—*N. oculata* (*Busk*).

Bass's Strait; Dr. Harvey.

3.—Onchopora (*Busk*).

1.—*O. hirsuta* (*Lamx. sp. ?*)

New Zealand; abundant; Dr. Joliffe.

Family 3.—Cellulariadæ (*Busk*).

1.—Cellularia (*Pallas*).

1.—*C. cuspidata* (*Busk*).

Abundant; Bass's Strait; Dr. Harvey. New Zealand; Dr. Joliffe.

A very variable species. In one form the spine on the median cell at the bifurcation is absent, and in another there are two to three orifices in the back of the cell.

2.—Menipea (*Lamx.*).

Cells oblong, abbreviated, or elongated and attenuated downwards; imperforate behind with a sessile lateral avicularium (frequently absent), and with one or two sessile avicularia (also frequently absent) on the front of the cell. Ovicell globular, immersed in the internode.

This genus requires careful revision. It is said to be distinguished from Emma (*Gray*) by the structure of the cell-mouth, which is subtriangular in the latter genus, the opening being partially filled up by a tubercular calcareous plate; and by the position of the lateral avicularium, which in Emma is entirely below the cell aperture; while in Menipea it is seated, when present, on the upper and outer angle of the cell.

The two new species are so completely intermediate that I believe I am justified in uniting the Emmæ with the true Menipeæ into what I conceive to be a most natural generic group. *M. ternata* (*Ellis*) may be taken as a type of the genus thus constituted. *M. Fuegensis* (*Busk*) approaches it closely. The avicularia are still at the upper angle of the

cell, and the cell-lip is still simple. The operculum, however, is reduced to a curved spine. In *M. Buskii* the lip is more projecting, and the calcareous plate which partially covers the cell-mouth is tuberculated. The lateral avicularium is slightly depressed, though still opposite the upper third of the aperture. The opercular spine is again expanded.

M. tricellata closely resembles the last in habit, but the tuberculated plate round the mouth is still more fully developed, the lip is more elevated, and the much smaller lateral avicularium is below the cell-mouth. The operculum is again reduced to a rudimentary spine.

M. cyathus is binate, the cell-mouth large and simple, as in *M. ternata;* the lateral avicularium very large half way down the cell-mouth. The operculum once more expanded and branched. It almost requires a microscope to distinguish *M. crystallina* (*Gray*) from the last, they are so similar in habit and general appearance; but in *M. crystallina* the expanded operculum is again absent, the lateral avicularia are reduced in size, and seated near the base of the cell, and the cell-mouth is again contracted by a granular calcareous plate.

The right of this genus to the name of Menipea depends upon the retention in it of the six-celled species, *M. cirrata* (*Lamx.*), of the propriety of which I think there can be little doubt. The general character is still remarkably the same. In *M. cirrata* a smooth plate covers the cell aperture, the lower part calcareous and fixed, the upper portion a movable, crescentic, horny operculum, closing over the true opening. I have not seen *M. Patagonica* (*Busk*), and from the figure I am more doubtful as to its position. All the species are distinguished by the presence of one or more sessile avicularia on the front of the cells, and by the remarkable hollow curved spines attached round the upper lip of the cell-mouth by horny joints.

This group does not seem to "fruit" freely. I do not know the ovicell even in our common British species, *M. ternata* (*Ellis*); but fortunately Dr. Harvey's collection contains a branch of *M. Buskii* from Bass's Strait, bearing several: globular, the surface granulated, immersed among the cells in the middle of the internode. One can scarcely doubt that all these closely allied forms have similar reproductive organs, and, if so, the ovicells will give an excellent generic character.

M. triseriata (*Busk*) and *M. multiseriata* (*Busk*), which have their ovicells galeate and superior, like those of Scrupocellaria, must seek other congeners.

I do not consider it necessary to subdivide the genus.

1.—*M. cyathus*, *n. s.* Plate XV., Figs. 10, 10*a*.

Cells very short and round; two in each internode, one a little above the other cell-mouth; large, oval, oblique; rim slightly thickened, five to six spines round the upper and outer margin; the lower three, large, curved, hollow, and pod-like, attached by a horny joint to the thickened lip. Opercular spine expanded, branched, spreading downwards and outwards from the upper and inner lip of the cell-mouth. A

large sessile lateral avicularium opposite the centre of the cell-aperture. Frequently an anterior sessile avicularium between the two cells of the internode. Internodes distant, connecting horny tube extending from the apex of a pair of cells, upwards and backwards, and slightly dilating as it enters the lower cell of the succeeding pair by its anterior aspect.

There is constantly on the front of the upper of the two cells a ring-like marking, usually filled up with a calcareous plate, but frequently giving off a horny, tubular tendril. At a bifurcation of the cœnœcium a third cell is introduced into the primary internode between the two secondary branches. Ovicell unknown.

A delicate parasitical species, twining its long tendril-like branches round zoophytes and red sea-weeds.

Bass's Strait; Dr. Harvey. Port Fairy; Mr. Dawson.

2.—*M. crystallina* (*Gray*).

Bass's Strait; abundant; Dr. Harvey.

3.—*M. Fuegensis* (*Busk*).

A single specimen; Bass's Strait; Dr. Harvey.

4.—*M. Buskii, n. s.* Plate XII., Fig. 1.

Cells elongated, attenuated downwards, three in each internode. Cell-mouth large, oval, oblique, the lower third filled up by a tuberculated calcareous plate; upper lip prolonged, and fringed with from four to five spines, attached to the lip by horny joints, and one of them, usually the second from the outer edge, very long, curved, and pod-like. There is often an additional spine on the upper and inner margin of the cell-mouth. Operculum spine strong and clavate, stretching upwards and outwards from the lower and inner lip of the cell-aperture. Connecting horny tube between the internodes double. Ovicell spherical, with a richly granular surface, imbedded among the cells, on the cavities of two of which it encroaches.

Van Diemen's Land; rather abundant, and in fine condition; Dr. Harvey. New Zealand; abundant; Dr. Joliffe.

5.—*M. tricellata* (*Busk*).

Bass's Strait; very common; Dr. Harvey.

3.—Scrupocellaria (*Van Beneden*).

a.—Operculatæ.

1.—*S. scrupea* (*Busk*).

Frequent on Algæ and Polyzoa.

Bass's Strait; Dr. Harvey. New Zealand; Dr. Joliffe.

2.—*S. ornithorhyncus, n. s.*

Cell-mouth rather small, oblique, a tuberculated crescentic plate below the lower lip. Upper margin fringed with four to five long

spines; pedunculate operculum prolonged upwards into a spine, which, with the superior spines, almost completes the circle round the true opening of the cell. Lateral avicularia very large. Vibracula small and obscure. Ovicell smooth.

A delicate transparent species, frequent, in small tufts, on sea-weeds and Polyzoa.

Bass's Strait; Dr. Harvey.

4.—Canda (*Lamouroux*).

1.—*C. arachnoides* (*Lamx.*).

Bass's Strait; abundant; Dr. Harvey.

Sect. 2.—Continua.

Subsect. 1.—Uniserialaria.

Family 4.—Scrupariadæ (*Gray*).

1.—Scruparia (*Oken*).

1.—*S. chelata* (*L.*)

Parasitic on *Caberea rudis* (*Busk*).

Bass's Strait; Dr. Harvey.

2.—Hippothoa (*Lamouroux*).

1.—*H. Patagonica* (*Busk*).

Bass's Strait; Dr. Harvey.

3.—Ætea (*Lamouroux*).

1.—*A. anguina* (*L.*).

Bass's Strait; Fremantle; Van Diemen's Land; Dr. Harvey. Port Fairy; Mr. Dawson. New Zealand; Dr. Joliffe.

2.—*A. ligulata* (*Busk*).

Bass's Strait; Dr. Harvey.

Subsect. 2.—Bi-Multiserialaria.

Family 5.—Farciminariadæ (*Busk*).

1.—Farciminaria (*Busk*).

1.—*F. aculeata* (*Busk*).

Van Diemen's Land; scarce; Dr. Harvey.

Family 6.—Gemellariadæ (*Busk*).

1.—Didymia (*Busk*).

1.—*D. simplex* (*Busk*).

Bass's Strait; a single fragment; Dr. Harvey.

2.—DIMETOPIA (*Busk*).

1.—*D. spicata* (*Busk*).

Bass's Strait; Dr. Harvey.

2.—*D. cornuta* (*Busk*).

Bass's Strait; parasitical on polyzoa; very abundant; Dr. Harvey. New Zealand; Dr. Joliffe.

3. CALWELLIA, *n. g.**

Cells in pairs, joined back to back. Each pair of cells arising by tubular prolongations from the pair next but one below it. Each pair having a direction at right angles to the next. At a bifurcation each cell of the primary pair giving off a secondary pair. Ovicell subglobular, placed immediately above and behind the posterior margin of the cell aperture.

1.—*C. bicornis, n. s.* Plate XV., Figs. 13 and 13*a*.

The only known species.

This genus supplies another link in the beautiful chain of modifications in the arrangement of cells in pairs furnished by the Gemellariadæ. By combining one of the peculiar characters of Notamia with a genera, appearance closely resembling Dimetopia, it affords another reason for retaining Notamia in the group, bearing, in fact, with the exception of the total absence of avicularia, the same structural relation to Notamia which Dimetopia bears to Gemellaria. The lower half of each pair is contracted and tube-like, the two tubes of which it is composed separating and curving over the walls of the inflated triangular upper half of the pair immediately beneath it. The cœnœcium is thus formed of two incorporated, independent rows of pairs of cells, all the cells of each row being in the same plane, but at right angles to all the cells of the other row. This somewhat complicated structure might be better understood if the reader would imagine another exactly similar double-stem incorporated at right angles with Fig. 13*a*, Plate XV.

The cell-mouth is small, nearly horizontal on the upper surface of the cell. The margin is thickened, rising at the outer angles of the nearly straight lower lip into a pair of strong, incurved, blunt spines. The cell-wall seems to consist of two membranes, and round the lower lip and at the base of the spines there are a few small, oval and round, fenestræ, passing apparently through one layer only. A small, granular, perforated papilla rises immediately below the cell-mouth, the oval aperture pass ing right through the cell-wall.

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* I dedicate this genus, at Dr. Harvey's suggestion, to Mr. Callwell, of Dublin, the well-known microscopist.

The ovicell is immediately above and behind the mouth of the cell, cemented against the triangular side of the pair of cells above, subspherical, slightly compressed, and beautifully marked, as if stamped with a miniature clam-shell.

The cœnœcium is very calcareous, forming delicate pure white, bushy tufts, about half an inch high.

It occurs sparingly with *Cellularia cuspidata* and *Dimetopia cornuta*, parasitical on *Catenicella ventricosa*.

Bass's Strait; Dr. Harvey. And on *Catenicella hastata*. New Zealand; Dr. Joliffe.

DESCRIPTION OF THE PLATES.

PLATE XIII.

Fig. 1. Catenicella crystallina, *n. s.*
Fig. 2. Ovicell of C. perforata (*Busk*).
Fig. 3. C. castanea, *n. s.*
Fig. 4. C. alata, *n. s.*

PLATE X.

Fig. 1, 2. Catenicella Harveyi, *n. s.*
Fig. 3, 4. C. gemmata, *n. s.*

PLATE XI.

Fig. 1. Catenicella Dawsoni, *n. s.*
Fig. 2. C. Buskii, *n. s.*
Fig. 3, 4, 5. Cothurnicella dædala, *n. s.*

PLATE XII.

Fig. 1. Menipea Buskii, *n. s.*
Fig. 2. Scrupocellaria ornithorhyncus, *n. s.*

PLATE XV.

Fig. 10, 10*a*. Menipea cyathus, *n. s.*
Fig. 13, 13*a*. Calwellia bicornis, *n. s.*

Specimens of the new genera and species were exhibited to the members.

The Ballot being opened, and the Rev. Eugene O'Meara, M. A., appointed Scrutineer, the following were declared duly elected as Ordinary Members :—

S. A. Brenan, Jun. Soph., and H. L. Smith, Sen. Fresh.

The Meeting was then adjourned to the 16th of April.

GEOLOGICAL SOCIETY OF DUBLIN.

GENERAL MEETING, WEDNESDAY EVENING, MARCH 10, 1858.

REV. PROFESSOR HAUGHTON, PRESIDENT, in the Chair.

THE Minutes of the last Meeting were read and confirmed. Donations were announced, and thanks voted.

The following gentlemen were elected Members of the Society:—1. J. Birmingham, Esq., Millbrook, Tuam, proposed by J. Beete Jukes, Esq., and seconded by G. Sanders, Esq.; 2. M. Alphonse Gages, Curator of Museum of Irish Industry, Stephen's-green, proposed by J. Beete Jukes, and seconded by G. Sanders, Esq.

DR. E. PERCIVAL WRIGHT read a paper by PROFESSOR KINAHAN—

ON THE ORGANIC RELATIONS OF THE CAMBRIAN ROCKS OF BRAY (COUNTY OF WICKLOW) AND HOWTH (COUNTY OF DUBLIN); WITH NOTICES OF THE MOST REMARKABLE FOSSILS.

IT is necessary to premise that this paper, or at least the subject-matter of it, was read at the recent Meeting of the British Association, and also embodies three communications of mine laid before this Society last year, but not published. I do not now seek to establish any theories, but simply to recapitulate the results to which an examination of the localities of Bray Head and Howth, together with a careful comparison of the remains with recent allied forms, have led. The age of the formation is admitted, I believe, by all, and, therefore, may be assumed as proved.

The two headlands, Bray and Howth, embracing, as it were, between them the Bay of Dublin, differ strikingly in their structure and in the fossils found, both as to amount and kind. A separate notice of each will be necessary.

Howth contains a large mass of Cambrian rocks, chiefly a very fine quartzose grit and slate breccia, with a few regularly schistose beds.

In the locality marked in the maps as Puck's Rocks I was fortunate enough last year to obtain *Oldhamia antiqua*, of which specimens were presented by me to the Museum of Irish Industry. Here also, as well as in the rocks about Candlestick Bay, immense beds of tubuli, similar to those markings called "fucoids," and so common in some Silurian formations, are met with. These have been proved to be tracks of wandering Annelids. What the true nature of both of these appears to be, I will discuss further on.

At Bray the character of the rocks is very constant. Beds of greenish quartzose grit, interstratified with beds of red or grayish-green schist, such as might be deposited in a quiet sea, and occasional masses of pure quartz rocks. In these proofs of organic life of three types at least have been found, viz., Zoophytic, Annellidan, and Molluscan (?).

I.—Zoophytic.

Remains of some zoophytiform animal, probably, judging from its form, Hydroid Sertularian. Two species are distinguishable, and have been named as following. One has been figured in Siluria, but both, up to this, are undescribed.

1.—*Oldhamia antiqua* (*Forbes*).

Polypidom cauliferous; stem percurrent filiform, with short, alternate, fan-shaped branches, arranged at regular intervals.

Occurs in beds, often some inches thick, massed together. There are two varieties of it found in Bray, the one having the fans so crowded as to render it liable to be mistaken for the next species, the other having the fans far apart and distinct. The beds in which this fossil occurs most abundantly at Bray, and all along the coast to Greystones, are greenish schist; it also occurs, but less abundantly, and smaller in size, in red schist. This latter may be a different species, being much smaller, and finer in texture.

The only species which has as yet been detected at Howth. There are striking differences between the specimens from thence and those from Bray. They, however, appear to be identical with specimens from Carrick Mount, county of Wicklow, in the collection of the Geological Survey.

2.—*O. radiata* (*Forbes*).

Polypidoms gregarious (?), short, many-branched; branches irregular, patent, thickened at the end, or many-branched, the branches sometimes arranged regularly in the form of a star.

Occurs in much thicker beds than *O. antiqua*. I am not quite sure whether the form from which the first part of the above description is taken belongs to this or a nondescript species: the more ordinary form has the characters described in the latter part of the description; the stars in the former measure 1·5 inch in diameter; in the latter 0·5 inch; the stem appears to have been extremely short; in one specimen there appear to have been oviferous capsules.

This is the most abundant species in the Bray beds; bed after bed of it occurring either as single beds, or in series of beds. One of these latter is fully five feet thick; the beds are either red or green schist. I have never met this at Howth, but it occurs abundantly, and very fine, at Greystones, county of Wicklow.

II. Annellidan.

These exhibit themselves as—

1st. Flattened, cylindrical, tortuous markings in the direction of the bedding, or nearly so; their structure ringed so that tearing them across gives the effect of a series of watch-glasses placed one within the other; evidently the exuviæ of worms wandering through beds of muddy sand, and leaving behind them in their course the sand which had contributed

its organic elements to their nutriment. They vary in their relation to the bedding, sometimes passing through it almost vertically. They do not present any traces of a tube, and may, therefore, be looked on as the tracks of worms similar in their habits to those which are at present to be found sometimes in myriads in ooze in which much organic matter is present. They occur in the beds in immediate connexion with the Oldhamia at Bray and Greystones, chiefly in the red beds, in immense numbers; more sparingly in the green beds, and also among Oldhamia, but evidently having no special connexion with it. They must have been very active when alive, or else extremely numerous, as the beds are in many places actually knit together by them.

Tubuli of a similar character are also found in Puck's Rocks and other localities at Howth, where, in the weathered rocks, they present an appearance similar to the so-called "*Fucoids.*" These latter may be, and probably are, formed by a distinct species from those at Bray, at least the mounds of *Arenicola piscatorius*, when disturbed, give an appearance very similar to them.

2nd. A series of thread-like tubuli, vertical to the bedding, having slightly trumpet-shaped openings, and arranged in pairs apparently identical with tubuli described as *Arenicola didyma*, in the rocks of the Longmynd, by Salter. These two forms have been figured by me in the volume of the "Natural History Review" for 1857, and also in the "Transactions" of this Society for the same year. They must have been formed in a still estuary. (*Vide* Plate I., Fig. 3.)

3rd. But by far the most remarkable form is that now to be described, and which, as far as I can make out, has not been hitherto known, viz., the tubes of

Histioderma Hibernicum (*mihi*) (ἱστίον, δέρμα) Plate VI., Figs. 1 and 2.

Worm inhabiting a tube and forming a mound. Tubes membranous, from 0·75 inch to 3 inches long, and 0·5 inch in diameter; vertical to bedding; superior extremity of tube trumpet-shaped; inferior turned up, and forming a chamber closed at the extremity.

Head of worm tentacled and branchiated; tentacle casts dichotomous, 1·0 inch, or upwards in length.

These are found in several localities at Bray and Greystones in a close greenish grit; they occur in profusion, and appear to have been in some of their habits, as to burrowing, not dissimilar from the common lug-worm (Arenicola) of our present seas, but the tentacles (?) are arranged similarly to those organs in Sabella or Terebella, to which they are probably allied.

They formed numerous mounds some inches in height, somewhat pyramidal in form, in centre of which was the aperture of the hole.

The beds in which they occur overlie the Oldhamia beds, and are many of them in a fine state of preservation, the ripple-mark, and other characters of the ancient shore in which they formed a prominent feature, being well seen. They were evidently Cephalo-branchiate; the wrinkles of their membranous tubes are easily seen in many specimens (Plate VI., Fig. 1.).

Histioderma Hibernicum has not occurred to me at Howth, and affords one of my reasons for believing the fossils there to be different from those at Bray.

These tubes appear to have been in texture similar to those of Trachyderma (Phillips), to which genus I at first referred them. An examination of the specimens of *Trachyderma coriaceum*, in the collections of the Museum of Practical Geology, Jermyn-street, London, and Museum of Industry, Stephen's-green, Dublin, have led me to believe that the habits of these two worms were very different. I have, therefore, formed a genus of them, named from the membranous texture of their abode. Among the fossils from Carrick Mountain (C. W.) is one which appears to be a portion of one of their tubes; they have also an analogy to the tubes of Aphrodite, one of which is figured, Plate VII., Fig. 4.

The seas in which their mounds were formed must have been moderately still, and left uncovered by the tide for but a short period, as no remains of the rounded excreta of the worms are to be found, as would have been the case had the beach been left for any length uncovered, as we see occurs in the case of *Arenicola piscatorius* of our extreme littoral zone, when compared with the labours of the same animals near high water-mark.

There are other markings in the Bray Head rocks which are probably Annellidan tubuli, lying in the same direction as the bedding; some of them twisted, but all rounded at the ends. These may be the casts of worms of a soft texture, but I have not satisfied myself at all on this point. A fine slab of them may be seen near the first wooden viaduct on the Wicklow line, near Bray, in a scratched rock.

The Annelid tracks reported from Howth as "fucoidal" in their characters resemble much the broken up tubuli made by Arenicola under the last-named circumstances. Fine specimens of all may be seen in the Museum of Industry.

III.—Molluscan (?)

The fossils thus called by me are raised tortuous markings, exactly similar to those so named in the carboniferous slates. They have been only met at Bray in a thin, green, gritty band, which traversed the red schist at the Ram's Scalp; they may be, and I think probably are, rather Annellidan, especially since amongst them we find peculiar remains similar to "*fucoids*," which here at least, I think, must be looked on as the broken tube casts of a burrowing Annellid. The bed in which they occur is subjacent to a grit bed of rather tough texture, which was evidently formed in a muddy nook of the Cambrian Sea.

Fine specimens of all may be seen in the Museum of Industry.

There are other remains seemingly organic here, but of uncertain nature. Among these I may mention what appears to be the track of an Acalephe, but I am not sufficiently acquainted with the forms of impressions made by these in the recent state to speak positively. *A. chrysaora* makes an impression extremely like that to which I allude; also cer-

tain wrinkled markings, possibly the casts of a flat Algal from both Howth and Bray. Time will not permit me to enter more fully into this interesting subject. Nothing remains, then, but to sum up the conclusions at which I have arrived from this examination, which are :—

1st. That at the period of the formation of these rocks the seas (?) in which they were deposited teemed with life of types similar in organization, habits, and conditions of life, with those in post-existent adjacent seas.

2nd. That these were Zoophytes (probably anthozoary) of at least two species: Annellides of several types, highly organized, and probably Mollusca and Acalephæ.

3rd. That, judging from the conditions in which these fossils are found, the animals lived, died, and were deposited in a shallow, quiet sea, and adjacent to some beach which was uncovered at certain intervals.

DESCRIPTION OF PLATES.

Plate VI., Fig. 2.—Head of tube of *Histioderma Hibernicum* (*Kin.*), showing crossing tracks of tentacle casts. Fig. 1.—Cast of middle of tube somewhat compressed, proving membranous nature of tube. Both from Bray Head.

Plate VII. Fig. 2.—Portion of slab from Ram's Skelp, Bray Head, exhibiting tracks. (Molluscan) (?). Fig. 1.—Closely crowded Annelidan tracks, from Puck's Rocks, Howth. Fig. 4.—Section of tube of *Aphrodite aculeata*, dredged at Bray (recent). Fig. 3.—Restoration of *Histioderma Hibernicum*, taken from actual specimen.

Mr. J. Beete Jukes said that, while investigating the rocks in the county of Kildare, near Old Kilcullen, he had discovered an Oldhamia, which had been pronounced as a new species in London; and, on comparing it with the one described by Dr. Kinahan, he was struck by the apparent similarity between the two.

Professor Haughton then left the Chair, which was taken by Mr. J. Beete Jukes.

Professor Haughton then read a description, by M. Delesse, of the Granites and Traps of Newry.

Mr. J. Beete Jukes read a letter from Mr. P. Stanley, of Tullamore, addressed to Dr. Apjohn, giving some description of the bogs of that neighbourhood. The writer stated that the substratum of the bogs in that part of the country was generally drift sands and gravels, occasionally intermixed with boulders, clays of a tertiary date being sometimes formed beneath, but always covered by drift. The bogs occur in patches varying in extent from a few perches to several thousand acres, and in depth from a few inches to thirty or forty feet. The shallow bogs consist of one stratum, the deep ones of four strata. The shell marl, sometimes occurring beneath the bogs, consisted chiefly of the remains of shells of a tiny aquatic snail, of a species which, if not extinct, is very scarce in the localities where it was once so plentiful. The snail is found at different

levels, varying as much as a hundred feet. Of the four strata of bog, the lowest is of a heavy black kind. In the stratum over this, large stumps of trees are found, oak and yew in the shallower bogs, or nearer the higher lands; fir and alder in the deeper bogs, and over the flattest lands.

The third stratum appears to be composed principally of heath, in some places giving place to black bog, in which iron ore is found abundantly. The fact of this iron ore having been "arrested by animalculæ" is alluded to, and its origin is referred, perhaps, to the iron pyrites existing in the Calp below.

The uppermost stratum of bog was said to be chiefly moss, and to have a considerable thickness, and that additions are being made to it every year.

The Meeting then adjourned to the second Wednesday in April.

GENERAL MEETING, WEDNESDAY, APRIL 14, 1858.

Rev. Professor Haughton in the Chair.

The Minutes of last Meeting were read and confirmed. Donations announced, and thanks voted.

1. Rev. H. H. Jones, Adare, county of Limerick, being proposed by Mr. J. Beete Jukes, and seconded by Dr. E. Percival Wright, was elected an Annual Member.

Mr. J. Beete Jukes read the following paper:—

ON A MINERAL FORMING THE CEMENT OF A BOULDER OF CONGLOMERATE, FOUND BY G. H. KINAHAN, ESQ., OF THE GEOLOGICAL SURVEY, NEAR LOUGHHILL, COUNTY OF LIMERICK. BY A. GAGES.

I owe to the kindness of my friend, G. H. Kinahan, of the Geological Survey, the first specimen of the mineral which forms the subject of the present communication. That specimen, however, was too small to enable me to make an analysis of it. But other specimens having since been procured by the Geological Survey, from the same locality, I have been enabled to make a more complete investigation of it.

The first specimen given by Mr. Kinahan appears to correspond with the description of Fischerite or Peganite, as given by Dufrenoy and Dana. It is composed of small crystals of an emerald green colour, mingled with some white ones, forming small mammillated concretions, cementing fragments of a quartzose grit.

In the other specimens received, the mineral forms the cement of a conglomerate of a black chert-like stone.

I am informed by the gentlemen of the Geological Survey, that the specimens come from a block found in the drift on the banks of the White River, four miles south of Loughhill, resting on coal-measures; blocks of limestone, trappean breccia, syenite, and granite, occur with it.

Wavellite has been found by Messrs. Jukes and Kinahan in the lower beds of the coal-measures, just above the limestone, about three miles north-west of Cahirmoyle.

This mineral exhibits slight pyro-electric properties. I made this observation on a small portion of the mineral carefully separated from the rock. As this mineral begins to lose its water a little above 100 degrees Centigrade, the experiments were made within that range of temperature.

The following are the results of my analysis :—

Water,	23·565
$Al_2 O_3$,	36·160
$Fe_2 O_3$,	1·812
PO_5,	30·881
$Si O_2$,	3·615
Oxide of Nickel, $Ni O$,	0·325
Apatite, PO_5, $3 Ca O$,	1·578
Fluorine,	traces.
Quartz,	1·003
	98·939

If we merely take into consideration the phosphoric acid, alumina, and water, the numbers just given would correspond to the formula :—

$$5 \left\{ \begin{matrix} Al_2 O_3 \\ \\ Fe_2 O_3 \end{matrix} \right. \quad 3PO_5 + 18 HO$$

Several minerals have been described from time to time, and classed with Wavellite, whose composition very much resembles the mineral now analyzed. Amongst those may be mentioned the Fischerite of Hermann, for which the formula $2Al_2 O_3$, $PO_5 + 8 HO$, has been proposed, and the Peganite of Breithaupt, which, according to Hermann, has the same composition as Fischerite, but only containing six equivalents of water.

One equivalent of the Irish mineral plus one of alumina, according to the above formula, should be equal to three of Peganite.

The green colour of the mineral analyzed by me is due to oxide of nickel, while that of Breithaupt's Peganite is, according to the analysis of Hermann, due to oxide of copper.

I merely propose the above formula as an expression of a single analysis; but I may observe, that it is quite evident that a great many phosphates of alumina have hitherto been confounded together as Wavellite, and that the complete examination of the whole of this series of minerals would be a desideratum.

I owe also to the kindness of Mr. Kinahan and the Geological Survey, a conglomerate of quartz, cemented by white Wavellite, and found at some distance from the first specimen. It is worthy of observation, that nearly all the varieties of Wavellite are concentrated in this carboni-

ferous locality, and as many of these minerals appear to be of a very recent origin, it may happen that some deposits of phosphatic minerals may exist in the locality.

Dr. E. Percival Wright read the following paper:—

ON THE OCCURRENCE OF A RARE FORM OF POSIDONIA BECHERI IN THE CALP OF RUSH, COUNTY OF DUBLIN, AND OF POSIDONIA LATERALIS IN THE CARBONIFEROUS SLATE OF KINSALE, COUNTY OF CORK. BY SIR RICHARD GRIFFITH, BART., F. G. S.

Palæontologists have hitherto been unable, with any certainty, to decide whether the genus Posidonia, or Posidonomya, should be regarded as a Conchifer, or as the internal plate of an animal allied to Aplysia.

The prevailing opinion, no doubt, tended to the belief that it was a bivalve shell, with affinities approaching to the family Aviculidæ, but as no example of a specimen exhibiting both valves, either closed or open, had been discovered, it was impossible to arrive at any satisfactory conclusion.

A very slight review of what has been written on this subject will be sufficient to show the importance of the present communication.

Professor Phillips ("Pal. Fos.," p. 44), in speaking of the genus Posidonia, says:—"It is remarkable that no case has come under my notice of a specimen in which the opposite valves were in exactly symmetrical apposition." And he further remarks that Bronn, the founder of the genus, gives a drawing ("Lethæa Geognostica," Pl. ii. Fig. 17*b*), which implies that he has seen such a one. But upon referring to Bronn's figure, it would appear to have escaped Mr. Phillips' notice that it is only given as an ideal side view (Ideale seiten ansicht), besides affording an idea of convexity, which we do not find warranted by the fact, making every allowance for compression.

Taking it for granted that the two valves of Posidonia have not been hitherto observed in apposition, I feel gratified in being able to bring forward a certainty in opposition to the ingenious conjecture of M. Deshayes, namely, that the fossils in question were thin, single plates, of the nature of the gill-cover of Aplysia,—a theory to which some probability has been attached by subsequent writers, from the resemblance which, though no doubt considerable, is yet quite insufficient to support a theory. Through the kindness of Dr. Farran, I have been enabled to compare one of these plates with the fossil; but the former is wholly deficient with respect to the aviculiform sub-auriculation, which is always displayed by the latter; the remaining features, such as the apparent umbo, and irregular concentric wrinkles, teaching us that mere general resemblances are frequently very delusive grounds of assumption, not only in this case, but in any other.

In the progress of my geological examination of the middle limestone, or calp rocks of Rush, near Dublin, at a place called Loughshinny, my attention was attracted to a very clearly-marked *Posidonia Becheri*, which I further found would afford conclusive evidence in reference to the settlement of the point in question. This specimen,

which is now before us, and of which a careful drawing has been made* exhibits the casts of both valves of *Posidonia Becheri* attached symmetrically by the oblique hinge characteristic of that genus, their position being exactly that which we have hitherto so much desired to see, and they are each marked by the regular concentric ridges which form an invariable feature in the identification of Posidonia.

The genus has been so long established, and its characters are so commonly known, that it will, of course, be unnecessary to enter upon any formal palæontological details in furtherance of the inquiry before us.

It will in this case be observed that the shell is nearly orbicular, differing in this respect from the obliquely elongated form which it usually presents, but we are aware that the species is subject to considerable variations in outline, as a series of specimens would exhibit gradations from the extreme of obliquity to such remarkably circular forms as the example before us affords.

Amongst numerous other specimens which have been collected at Loughshinny, there is only one in which a faint trace of two valves can be discerned; so that it would appear that the occurrence of such a fossil as that before us is an unusual circumstance.

I may, however, observe that the consideration which has heretofore been chiefly relied on, in justification of the doubt regarding the affinities of Posidonia, namely, the absence of the valves in apposition, has had an importance attached to it which, it appears to me, was not sufficiently borne out by such a circumstance; as any one, even the most cursory observer, cannot fail to have remarked that amongst the numerous variety of shells which lie scattered on most sea-shores, comparatively few are found with both valves attached, either closed or open, and the longer such remains lie exposed to the vicissitudes to which, from various atmospheric and mechanical causes, they are subject, the chances in favour of ligamentary attachment will be continually lessening. Of course I am aware that the force of a consideration apparently so simple is very much increased by the light which such a discovery as that before us affords; very simple circumstances, from which correct inferences might be drawn, being often overlooked in the absence of tangible facts. A similar remark applies to fossil bivalves generally, as in comparatively few instances do we find both valves attached, while the occurrence of single valves is most commonly to be observed.

As an exemplification, I might select the case of the genus Aviculopecten, which in its numerous species rarely presents to our view more than a single valve, though (as has been completely overlooked in the case of Posidonia) the right and left valve of the same species unattached are frequently found to occur, thus enabling us to arrive at as certain a conclusion (and in both cases equally) as if we were in possession of the accidental fact of apposition.

In addition to the collection which I have made, the President has enabled me to exhibit specimens obtained by him from the same locality,

* See Plate XVIII., Fig. 1.

in one of which a portion of the shell itself has been preserved, and, notwithstanding its thinness, it does not exactly justify the anticipation we might have formed relative to its membraneous or extremely fragile character, its thickness being not inaptly compared to that of an egg-shell; and when we remember that these fossils are, for the most part, mere impressions, the fact of the ridges of different individuals crossing each other in various directions will occasion no surprise; nor can we necessarily conclude that the shell was flexible on that account: on the contrary, we are now aware that it was of a firm and brittle texture.

The President has also kindly favoured me with another specimen which, though it would have been insufficient without the aid of my more perfect fossil to determine the inquiry satisfactorily, is yet very valuable, as affording a repetition of the fact we are considering; and I am happy to find that Dr. Carte, whose attention has been directed to the subject, has lately succeeded in procuring a third* example in which the bivalve structure can be clearly traced; and though, in common with many other lamellibranchiate fossils, the closed valves in apposition have not been hitherto observed, yet I should say that a positive statement as to the non-existence of such a case would be a very unsafe position, as we are not in a condition to say that the opposite valve may not be present in many cases, though concealed in the adhesive matrix of surrounding shale.

Little need be said further as to the shell itself, except that it were to be wished that some more satisfactory mode of defining the present species (if not of the whole genus) existed, as one sometimes feels a difficulty in ascribing identity, or the contrary, to such varied forms as frequently present themselves; and it may be worth our notice how far some of the species at least, which at present are regarded as belonging to the genus Inoceramus, may not rather form a portion of the genus Posidonia, a consideration probably of some importance with respect to the geological bearings of the subject.

In the strata alternating with the fine-grained dark shales which contain Posidonia, as well as in those latter, we find the carboniferous fossils, *Fenestella*, *Productus concinnus*, *Goniatites reticulatus* and *spiralis*, the last-mentioned (which has been frequently supposed to be an Orbicula) being obtained perhaps in a better state of preservation and of a larger size in the shales of Rush than in those of any other locality in Ireland. Vegetable remains are also of frequent occurrence in the Goniatite beds, and these remains are undoubtedly identical with those occurring at the Naul and Clontarf, which have been described and figured in a former Number of our Journal by my friend Professor Haughton. *Posidonia membranacea* is likewise very abundant in this locality, but it is difficult to procure a good cabinet specimen of the fossil, owing to the rapid decomposition to which the external surface

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* Mr. Hargrave, one of Mr. Haughton's pupils, has recently obtained another specimen, showing both valves, from the neighbourhood of Rush. See Plate XVIII., Fig. 2.

of the shale is liable; and Dr. Carte has recently succeeded in procuring a specimen of *Posidonia lateralis* in the same strata which contain the fossil under our consideration.

As to the geological bearing of the question, it may be observed that the Calp, or middle limestone rocks of Ireland, in the shales of which Posidoniæ occur so abundantly, are interposed between two blue subcrystalline limestones, to which I have applied the relative terms Upper and Lower, one of them (or, perhaps, to a certain extent both) being the equivalent of the mountain limestone of England. These Calp strata consist of impure siliceo-argillaceous limestone, interstratified with shales of various degrees of hardness, which frequently contain layers of chert, and it is in the shales and impure shaly limestones of finest grain that we find the matrices of the Posidoniæ, as appears from the specimens now before us.

There are, besides, occasionally interstratified with the shales at Rush, remarkable fossiliferous conglomerates, the pebbles of which vary from a size nearly half a foot in diameter to very small angular and rounded fragments of slate, limestone, and quartz, which are probably of Silurian age; and we have likewise other conglomerates, containing very numerous pebbles, which may possibly be regarded as carboniferous limestone, the appearance which they present being exactly similar to such recent breaches of shingle as may be observed at several points on the same shore. Blue fossiliferous limestone, containing *Naticopsis Phillipsii*, &c., occurs as we approach the town of Skerries; and I may remark that my friend Professor Jukes, who has minutely examined this interesting locality, is of opinion that it is difficult to determine the position of this limestone in the series, owing to the disturbance of the strata, as, for all we can say, it may represent either the upper or the lower limestone, and may possibly include both.

The Calp series, which is always of a dark gray colour, becomes occasionally separable into an upper and a lower portion, as in the north of Ireland, by means of a considerable thickness of intervening hard, compact, yellowish gray sandstone, an incipient representative of which may be observed in the Knockmaroon district of the county of Dublin. It may be useful to supply a few of the localities in Ireland in which the Posidoniæ have been found to occur most abundantly in the calp series. They have been principally obtained in the shales near Nobber, at Cruicetown, and near Navan, at Walterstown, in the county of Meath, also near Balbriggan, at Courtlough, and near Skerries, at Baldongan, as well as near Rush, at Loughshinny, already mentioned, in the county of Dublin; but no doubt they occur in the fine-grained dark gray shales in many other localities, as I am informed by Mr. Jukes that they have been collected in the neighbourhood of Garristown, also in the county of Dublin.

It would exceed the design of the present communication to enter into further details with reference to the remarkable geological features which can be studied with so much advantage in the vicinity of Rush, especially as we may expect that the President, as well as Mr. Jukes, will favour us with their views; but I may observe that probably there

will be found in few places, within a small compass, such a variety of interesting examples of study as we have presented on this shore, the convoluted strata of which form, in fact, a natural model, as it were, of abstract Geology.

Immediately above the upper carboniferous limestone, and conformable with it, lie beds of the millstone grit series, or, as in reference to Ireland they might be called, the marine coal formation, from the occurrence of marine fossils in abundance, which are characteristic of the carboniferous limestone series generally. These fossils consist of Zoophytes, Crustacea, Brachiopoda, Conchifera, Gasteropoda, and Cephalopoda. This series in Ireland is divisible into an upper and lower sandstone or grit (in which are frequently found casts of Lepidodendra and Stigmariæ), having a considerable thickness of fine-grained, dark gray shale interposed, in which latter numerous beds of argillaceous ironstone are intercalated; and it is these shales which contain such a numerous variety of marine fossils of the ordinary carboniferous type, as I have mentioned above, the *Aviculo-pecten papyraceus* characteristic of the formation, as in England, being abundant throughout. As in the case of those of the Calp series, so in the finer-grained shales of this formation, casts of Posidonia in great profusion are found to occur, and the several varieties of form in both cases are identical, such as *Becheri*, *lateralis*, and *tuberculata*, though some of those of the smaller sort may possibly be new, and others would appear to be of the genus Inoceramus. Ferns, *Sigillariæ* and *Lepidodendra*, are also abundant, and we occasionally meet with interstratifications of flaggy fossiliferous limestone. The localities in which Posidoniæ most abound are near Ennistymon, in the county of Clare; Ballybunnion, in the county of Kerry; Braulieve Mountains, in the county of Sligo; Cuilcagh Mountain and the Alteen River, in the county of Cavan; Corry,* near Drumkeeran, in the county of Leitrim; and Mullaun and Carrownanalt, near Keadue, with the Munterkenny Mountains, in the county of Roscommon.

Before closing this communication, I should wish to mention that in making researches relative to the persistence of the genus Posidonia, I have ascertained its occurrence at the base of the carboniferous series in the suite of rocks to which I have given the name "carboniferous slate," in the Geological Map of Ireland; and I think it may be desirable to make some reference to this fact, as well as to give a short description of the strata of this lower series. These rocks (typical in the south of Ireland) consist of cleavable slates or shales, the colour of which varies from dark gray to greenish or yellowish gray,—the former, however, being the predominating tint. The shale beds are usually interstratified with compact sandstone, and occasionally with limestone, the latter being sometimes of considerable thickness; the whole lying conformably beneath the lower limestone, and similarly resting on the sandstone, for which I have hitherto adopted the term "yellow sandstone," to distinguish it from the subjacent and conformable beds of the true, and pro-

* See Plate XVIII., Fig. 3.

bably non-fossiliferous, Old Red Sandstone. Both these subdivisions—namely, the carboniferous slate and yellow sandstone—are so immediately connected, and pass so insensibly into each other, stratigraphically as well as by fossils, that I have classified them on the map as one series, under the term "yellow sandstone group."

It is in the carboniferous slate or shale, the upper member of this group, at Lispatrick and other localities of the same district, near the Old Head of Kinsale, in the county of Cork, that the impressions of Posidoniæ occur, to which I have referred; and they are accompanied by numerous other ordinary carboniferous fossils, especially by the *Goniatites striolatus*, the surface of which is ornamentally pyritised; and I may in addition enumerate *Orthis crenistria*, *Spirifer attenuatus*, *Turbinolia fungites*, &c. There is much difficulty in this locality in procuring specimens in a sufficiently perfect state for identification, the portions of the impression most necessary for that purpose being generally imperfect, owing to the scaling and crumbling nature of the shale, as well as to the distortion produced by the action of cleavage on the one hand, and, on the other, by those portions remaining hidden in the rock being cut off by innumerable cross or dip joints, which are frequently less than half an inch asunder; and in this respect they are quite similar to those which occur in the Calp of Rush. The *Posidonia lateralis** now before us, as represented in the diagrams I have prepared, will be seen to have been much extended in the direction of the longer axis of the shell by the action of cleavage, but I think the distortion will yet hardly amount to such a degree as to render the specimens incapable of identification with those usually figured as *P. lateralis*. The impression,† as represented in the diagram beneath the former, may possibly be the same species, the extension being parallel to the direction of the shorter diameter of the shell; but I shall leave the consideration of this subject in the hands of the Reverend President, who is so much better qualified than I am to discuss its bearings, not only from the attention which he has already directed to it, but from the researches in which he is at the present moment engaged, and from which we may expect in future such valuable results.‡

Immediately accompanying the *Posidonia lateralis*, in the same bed, I have discovered a very beautiful and remarkable *Avicula*,‖ which is represented by the lower figure in one of the diagrams; and as I do not remember to have seen it before, it may probably be new, but it is at least very valuable from the unusually perfect state in which it is preserved,—a circumstance which is very rare in cleavable rocks, as may

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* See Plates XVI., XVII. † See Plate XIX., Fig. 2.

‡ *Note added in the Press.*—Subsequently to the printing of my paper, the President has kindly undertaken to add a note in reference to the effect which cleavage produces in the distortion of fossil forms. The note alluded to is printed in full, page 161. Mr. Haughton has also given a review of the genus, which, it is to be hoped, will tend to simplify its specific diagnosis.—R. G.

‖ This fossil has been unfortunately mislaid in London, so that, being unable to figure it sufficiently accurately, I prefer to omit it in the Plates.—R. G.

be observed from the great variety of forms of distortion afforded by the Posidoniæ of Kinsale.

I have thus shown that Posidoniæ occur in the fine-grained, dark-coloured shales throughout the entire range of the carboniferous series in Ireland, from the base of the marine coal formation to the upper portion of the yellow sandstone group of strata; and it is remarkable that in both cases they are accompanied by the fossil, *Goniatites striolatus*. It only remains to remark, in conclusion, that notwithstanding the prevalence of these fossils in certain groups of strata, they would rather seem to afford an indication of mineral conditions and of mechanical depositions than be of rigid application in the determination of geological subdivisions, as it appears that their presence is dependent upon the predominance of argillaceous rather than of calcareous or siliceous matter in the bottoms in which they are found; but, however this may be, we can safely affirm that they are eminently characteristic of the carboniferous series; and it is satisfactory to be able to prove that these remains were true lamellibranchiate bivalves, as given in the Table of Fossils appended to my Geological Map of Ireland.

NOTE ON THE ALTERATION IN THE FORM OF POSIDONIA PRODUCED BY CLEAVAGE AND THE PRESSURE OF THE SURROUNDING MATRIX. BY THE PRESIDENT.

I HAVE carefully examined the form of *Posidonia Becheri* from the elliptical rings, in specimens in the Museum of Trinity College, brought from Herborn in Nassau. The ratio of axes of the adult shell is 1·38.

The specimen, Plate XVIII., Fig. 3, from Corry, Drumkeeran, has a ratio of 1·40, and is identical with the *P. Becheri* of the Germans.

Plate XVIII., Fig. 2, represents a variety, with broad, deep annulations, found in the harder beds of impure shaly limestone at Rush, county of Dublin.

Plate XVIII., Fig. 1, represents a nearly circular variety.

The specimens figured in Plates XVI., XVII., and XIX., are from the highly cleaved Carboniferous Slate of Kinsale Head. I believe them to be all *P. Becheri*.

In the type shell, unfortunately, the elliptical lines of growth are oblique to the hinge-line, which is very indefinitely marked, and in consequence it is difficult to say, in the case of the distorted fossils, what the original position of the hinge and elliptical lines may have been. I have, therefore, found it impossible to calculate numerically the amount of distortion, as the original position of the shell is unknown, and it was not circular. There is, however, a general agreement with the laws of distortion of fossils, as laid down by me in the "Phil. Mag." vol. xii., 1856. This is shown by the following series of numbers, which express the ratio of axes and angle between cleavage and bedding in the several cases.

It is to be observed that the major axes of the distorted elliptical rings are always parallel to the intersection of cleavage and bedding, whatever may have been the position of the rings originally.

Ratio of axes.	Angle between cleavage and bedding.	Plate.	Fig.
2·11	22°	XIX.	2.
1·96	42°	XIX.	1.
2.58	53°	XIX.	3.
3·03	57°	XVI.	2.
3·45	56°	XVII.	1.
3·75	unknown	XVI.	1.
4·44	62°	XVII.	2.

It appears from the preceding that, with some exceptions, which could be explained, probably, if the original position of the shell were known, the ratio of axes of the shell increases with the angle between cleavage and bedding; and that all the shells are probably of one species, as the variations of form are attributable to the distortion produced by cleavage.

DESCRIPTION OF PLATES XVI., XVII., XVIII., XIX.

PLATE XVI.

Figs. 1, 2. Valves of *Posidonia Becheri* distorted by cleavage, as shown in the drawn-out condition of the rings of growth.

If m and n denote the axes parallel and perpendicular to the intersection of cleavage and bedding; and ϕ the angle between these planes—

Fig. 1. $$\frac{m}{n} = 3{\cdot}75.$$

Fig. 2. $$\frac{m}{n} = 3{\cdot}03, \quad \phi = 57°.$$

Locality: Old Head of Kinsale, county of Cork.

PLATE XVII.

Fig. 1. Similar to last—

$$\frac{m}{n} = 3{\cdot}45, \quad \phi = 56°.$$

Fig. 2. This specimen has undergone more distortion than any of the others, and is, therefore, more likely to be magnified by the species-maker into a new variety. I believe it to be simply *P. Becheri*, after a very severe stretch—

$$\frac{m}{n} = 4{\cdot}44, \quad \phi = 62°.$$

Locality: Old Head of Kinsale, county of Cork.

PLATE XVIII.

Fig. 1. *P. Becheri*, almost circular variety, showing both valves. The beds at Rush in which it is found are much distorted, but show no signs of true cleavage—

$$\frac{m}{n} = 1 \cdot 09.$$

Locality: Loughshinny, county of Dublin.

Fig. 2. *P. Becheri*, with broad, deep annulations; showing both valves; cut off abruptly by one of the joint surfaces which are common in the distorted shale of Loughshinny, Rush, county of Dublin, where these fossils are found in abundance in the black shale beds between beds of crinoid and spirifer limestones.

Locality: Loughshinny, county of Dublin.

Fig. 3. Typical specimen of *P. Becheri* from Corry, Drumkeeran, county of Leitrim, where it is found in blue shale, resembling the dark mud beds of Rush and Kinsale—

$$\frac{m}{n} = 1 \cdot 40.$$

Locality: Corry, Drumkeeran, county of Leitrim.

P. Becheri.—Testâ obliquâ ellipticâ, vix concameratâ; costis multis, bene figuratis, culminatis, concentricis; umbone parvulo vix eminente, in medio cardinis recti posito.

Professor Bronn considers Posidonia to belong to the Aviculaceæ, and to be intimately allied to Inoceramus. He unites with *P. Becheri* both *P. lateralis* and *P. tuberculata*, figured in Sedgwick's Account of the Geology of Devonshire.—Trans. Geol. Soc. London, second series, vol. v. Plate LII.

In this union of species I fully concur, and think it would be highly interesting to know whether the specimens figured by Sedgwick were found in cleaved beds or not.

The generic character is thus given by Bronn:—

Posidonia:—Shell equivalved, unequal; oblique oval, or roundish; very thin; both externally and internally concentrically wrinkled; the hinge-line straight, long, forming an angle with the rim of the shell, both before and behind the scarcely prominent beaks.

PLATE XIX.

Figs. 1, 2, 3.—Specimens of *P. Becheri*, variously distorted by cleavage.

Fig. 1. $\frac{m}{n} = 1 \cdot 96, \quad \phi = 42°.$

Fig. 2. $\frac{m}{n} = 2 \cdot 58, \quad \phi = 53°.$

Fig. 3. $\frac{m}{n} = 2 \cdot 11, \quad \phi = 22°.$

Locality: Old Head of Kinsale, county of Cork.

Dr. E. Percival Wright opposed the idea that Posidonia was an Entomostracan shell, or that it was at all allied to Aplysia; on the contrary, he believed it to have been a molluscous animal, whose affinities approached very near to those of Avicula; and he thought that the specimen exhibited by Sir R. Griffith completely settled the question.

Professor Haughton believed that the strata between Rush and the Skerries could not be more than 200 feet thick, and that the mud strata in which Posidonia and the Goniatites occur were identical. These mud bands occurred between strata of crinoid limestone, in which Fenestellæ are found. He thought that these mud bands were of fluviatile origin, their dark colour being due to the presence of plants, the conglomerate accompanying them indicating a sea shore. The various species of Posidonia might be, perhaps, referred to one, when the distortion due to cleavage was taken into account.

Mr. J. Beete Jukes fully concurred with Sir Richard Griffith as to the great rarity of finding both valves of Molluscan shells, even in a recent state; he had not been able accurately to refer the Conglomerate of Rush to either the upper or lower limestone series.

Lord Talbot de Malahide then took the Chair.

The President read a paper—

ON REVERSED FAULTS OCCURRING IN ANTICLINAL FOLDS WITH OBLIQUE AXES, ILLUSTRATED BY A CASE AT LOUGHSHINNY, COUNTY OF DUBLIN.

Having recently had occasion to study somewhat carefully the conditions under which reversed faults occur, and having arrived at some results, which, so far as I know, have not been published hitherto, I thought it might be useful to lay them before the Society, in the hope that the circumstances under which reversed faults occur may be noted occasionally, and thus more facts collected, on which to construct a complete theory of the forces which have given rise to them.

It is well known to engineers that if a bank of earth be retained by a vertical revetment wall, there is a certain plane, which may be called the *natural plane of slipping*, along with there is the greatest tendency of the bank to slide. If u denote the underlay (or angle with the vertical) of this plane, and ϕ the angle of friction between the masses of which the bank is composed; then—

$$u = 45^\circ - \frac{\phi}{2}. \tag{1}$$

If, from any cause, the bank of earth should tend to slip down some other plane, not the *natural plane of slipping*, then the horizontal force necessary to keep it from so slipping is,

$$P = \tfrac{1}{2}\mu x^2 \tan u \cot (u + \phi); \tag{2}$$

where μ denotes the weight of a cube foot of the bank, x the height of the revetment wall, and P the force per linear foot of breadth requisite to keep the bank from slipping.

If this engineering problem be inverted, and a geological one substituted for it, viz., to find the horizontal force necessary to produce fracture in a mass of rock or gravel, it is not difficult to infer the following results :—

I. If a horizontal thrust be applied to a bank of rock (Plate XX., Fig. 1), there is a certain plane *oa*, along which the fracture of the rock mass is easiest, which I shall call the "*Natural Plane of Fracture*," determined by the equation—

$$u = 45° + \frac{\phi}{2}. \tag{3}$$

II. There is a certain other plane *ob*, which I shall call the "*Plane of impossible Fracture*," up which it would require an infinite force to push the rock mass. This plane is determined by the condition—

$$u = \phi. \tag{4}$$

III. If, from any cause, the fracture of the rock mass take place along some other plane *ox*, the force requisite to push the mass up the plane is determined by the condition—

$$P = \tfrac{1}{2}\mu x^2 \tan u \cot (u - \phi). \tag{5}$$

The second case is illustrated in Plate XX., Fig. 2, which represents the reaction of the plane of impossible fracture as horizontal, because $\phi = u$, and therefore it would require an infinite force to push the weight up the plane.

In Fig. 3 I have illustrated a remarkable case of oblique anticlinal axis, occurring at Loughshinny, county of Dublin, with fracture along the inclined line of overturned beds *xy*, and a slight reversed fault along the plane of fracture. The figure is accurately drawn with respect to the inclination of the beds and of the fault.

The bed *a′b′* is a bed of crystalline crinoid limestone, and is the first which has undergone fracture. Its inclinations are 25° and 55° at each side of the axis, and the underlay of the fracture *xy* is 50°.

The planes *oa* and *ob* are the "planes of natural fracture and of impossible fracture," and their underlay, as found from equations (3) and (4) are—

$$oa = 62°\ 30',$$
$$ob = 35°;$$

assuming ϕ to be 35°, which cannot be far from the truth.

The actual plane of fracture *xy* is intermediate between these two planes, and is occasioned by the plane of weakness caused by the bending over of the contorted strata.

Equations (2) and (5) give the forces requisite to keep from slipping down and to push up a mass of rock along any given plane *ox*; and since the weight of the mass kept from slipping down or pushed up is—

$$W = \tfrac{1}{2}\mu x^2 \tan u; \tag{6}$$

by substitution these equations become—

$$P = W \cot (u + \phi), \qquad (7)$$

$$P = W \cot (u - \phi). \qquad (8)$$

As the rock mass in this case has been slightly pushed up the slope xy, we are to use equation (8) to find the horizontal force requisite to produce this *reversed* fault—

$$P = 3{\cdot}73 \times W.$$

It therefore required a horizontal force little less than four times the weight of the rock mass to cause the reversed fault.

If we wish to know the force requisite to prevent a *direct* fault, we must use equation (7)—

$$P = 0{\cdot}087 \times W.$$

If the horizontal force be less than about one-twelfth of the weight, and the line of fault already established, a *direct* fault or slip would occur.

Such a force as this could never cause the overturning of the beds, or produce a reversed fault; and this latter kind of fault may occur whenever fractures of overturned oblique anticlinal and synclinal axes take place along the bend of the curves of strata.

The Meeting then adjourned to the second Wednesday in May.

GENERAL MEETING, MAY 12, 1858.

THE PRESIDENT in the Chair.

THE PRESIDENT exhibited, on the part of George M'Dowell, Esq., an ornament partly composed of aluminum.

The President then read his paper on the occurrence of Gray Copper in the Yellow Sandstone near Boyle, county of Roscommon. The copper occurs in red slate, at a depth of about 2640 feet below the base of the Carboniferous Limestone.

The President pointed out the analogy between this occurrence and that of copper in the south of Ireland, in similar beds, and that in each case the copper ore was either gray copper or blue copper, and never copper pyrites.

Mr. J. Beete Jukes remarked on the singularity of the diffusion of copper in particular beds in the south-west of Ireland, and in the same beds in the north; and pointed out that light might possibly be thrown on the question of the deposit of ores in mineral veins by any one who would observe the relations between the ore in the beds and that in the lodes at Coosheen and elsewhere.

The President then read his paper on the occurrence of some new and rare forms of Annellidoid tracks in the coal-measures of Lugacurren, Queen's County. He illustrated his paper by rough drawings, separating them into two sets, of which he believed one to be a molluscan track,

and another with a curious punctured impression in the centre passing into linear marks.

Dr. Kinahan made some remarks, in which he stated his belief that all the tracks were molluscan, basing his argument partly on the sharpness of the turns, mollusca turning much more rapidly than worms could.

Mr. Mallett and Mr. Jukes made some observations; the latter calling attention to some enormous tracks in coal-measure flagstones, to be seen in the Museum of the Geological Society of Manchester.

Mr. J. B. Doyle then exhibited some fine examples of fossil corals from Devonshire. These consisted of polished specimens from Newtown Abbot and other places.

Dr. J. R. Kinahan exhibited a series of fossils from the marine drift of Bohernabreena, county of Dublin. These consisted of angular, slightly rolled fragments of *Cyprina islandica*, *Tellina solida*, *Mactra solida*, *Ostrea edulis*, *Pholas* —— ? *Venus striata* and *casina*, and of a valve of Balanus unrolled, and unrolled specimens of *Nucula tenuis* and *Turritella communis*. He described the portion of the drift in which they occurred as being made up of coarse, angular, scarcely rolled fragments, cemented together with carbonate of lime. The drift in which the shells occurred lies on the corn gravel, and preserves everywhere the same character, of having mixed up in it a large proportion of but slightly rolled pebbles, being very distinct from the ordinary gravel of the neighbourhood, which is nearly entirely made up of rolled and rounded pebbles, and apparently, in a great measure, the results of the wearing down and breaking up of the gravel by the action of water. The whole appearances would suggest the idea that the gravel in which the shells occurred had been subjected to the action of a violent surf, which had broken up the deep sea-shells, such as *Cyprina islandica*, and tossed them up unrolled, with specimens of the more immediate inhabitants of the littoral. This would account for the hinge teeth and striæ of such shells as *Nucula* and *Venus striata*, and *casina*, being preserved comparatively uninjured, and for the fine condition of the valve of the Balanus exhibited. In the course of the Paper occasion was taken to advert to the importance in drift deposits of remarking the conditions and characters of the fossils; and it stated that fossil shells, in the more recent deposits, were easily divided into *shells in situ*, where the animals had lived and died in the deposits, and the shells were thence generally found perfect; and *transported shells*. That these latter might be either shells of inhabitants of deeper zones, on which the action of the sea had been but brief (such as a surf), as in the present instance, the striæ, &c., of the shells in this case being preserved, although the shells were generally broken and mixed with unbroken shells of littoral molluscs, &c.; or they might be shells which had been subjected to the frequent action of the water, as on a sandy beach or gravel shingle, where the force of the water was comparatively small, but long continued, and the shells in consequence polished, and all the striæ worn off; the pebbles in which they occur, in this case, being mostly rounded, with but few angular fragments among them. A third set of transported shells were those which, having

been once buried in the drift, and then elevated, were afterwards unburied by the wearing away of those beds in which they lay, and then reburied in the more modern beach. These shells were invariably rubbed, and also generally much corroded. General remarks on the various modes in which beaches were formed, and the evidences of the mode of their formation, concluded the paper. The shells had only occurred in two localities—one immediately above Bohernabreena. This was pointed out some years since by Professor Scouler. The second, about half a mile lower down the river, in the old Fox-earths, on the opposite side of the river.

The President and Mr. Mallett made observations on the paper. Mr. Mallett pointed to the Escar of the Green Hills as an old tidal bar of the Dodder Valley, and alluded to the scratchings and the present position of the drift, as formed by subsequent slippages.

Dr. Kinahan applied and accepted Mr. Mallett's explanation of the bar origin of the Escars as explaining also the absence of shells in them.

The Meeting then adjourned to the second Wednesday in June.

GENERAL MEETING, WEDNESDAY EVENING, JUNE 9, 1858.

The President in the Chair.

Professor Kinahan read a paper on the Raised Sea Beaches of Port Philip, Victoria, observed by him in the year 1855. He stated that the great portion of coast consists of raised sand-hills, containing shells, and broken in two or three places by projecting rock; that these sand-hills are frequently backed by a lagoon or arm of the sea, gradually separated from it, and in some instances communicating with it at high tide. In some places sections of these sand-hills are made by the sea; from which Professor Kinahan drew the conclusion that the whole beach had been subject to three periods of submergence and elevation.

William H. Baily, F. G. S., read the following paper—

ON A CRUSTACEAN FROM THE COAL-MEASURES, WITH SOME REMARKS ON THE GENUS LIMULUS.

The fragment of shale on which these interesting remains of Crustacea are impressed was collected by George Henry Kinahan, Esq., of the Geological Survey, in the Bilboa Colliery, county of Carlow, from the three-foot bed of black shale immediately over the coal, associated with plants, and small fresh-water bivalves allied to Unio.

The specimen exhibits the upper surfaces of three detached cephalic shields, evidently belonging to one species, and presenting generic characters similar to those peculiar forms of Crustacea found in ironstone nodules of the lower coal-measures at Coalbrookdale, Shropshire. Although the only parts of this species, yet discovered, are the separated heads or cephalic shields, their generic identity with those from Coal-

brookdale is easily recognised, and the specimens, so far, are sufficiently well preserved for description.

Before doing so, however, I would offer a few remarks on the genus Limulus, in which all these coal-measure Crustacea have been hitherto included, and which I now propose, from their greater affinity with the Trilobites, to remove, and constitute a new genus under the name of Steropis, for the following reasons. In the first place, their general form and size bear a much stronger resemblance to several of the Trilobites than they do to the recent Limulus, from which it differs in possessing (although not so perfect as in the Trilobites) a more distinct trilobation, with the abdomen separated into segments. The abdominal or caudal shield corresponds almost completely in point of size and form with that of Amphyx, Trinucleus, &c.; and the characteristic spiny termination of the pleuræ to that of Acidaspis and Paradoxides. The possession of legs and articulation of the caudal spine, which they are said to be provided with, would connect them with the Jurassic and recent Limulus; although there is a striking analogy to the latter case presented by some of the Silurian Trilobites, as *Phacops longicaudata*, in which species there is a great prolongation of the caudal extremity into a spine, which is, however, destitute of articulation.

The presence of a facial suture, which I have detected in the species hereafter described, would offer still greater affinity to the Trilobites, as being peculiarly characteristic of that group.

The great difference, in point of time, between the deposit of the lower coal-measures, in which Crustacea of this character first appears, and the upper Jurassic, where they approach very closely to the recent forms, would again account for their closer alliance to the Trilobites, thus leading on in beautiful gradation to that great and important group of the Crustacea which is characteristic, and obtains their maximum development in the older palæozoic rocks.

Two species of the genus Limulus are recorded as occurring in the Muschelkalk, but in the upper Jurassic formation they are found in fine preservation, six species having been described from the cream-coloured slates of Solenhofen and Pappenheim. They approach much nearer in size and form to the recent Limulus, having distinct legs, with an evidently articulated tail,—the differences, therefore, being so slight, it would, perhaps, be advisable to retain them in the same genus.

The recent forms of Limulus, to which the King Crab belongs, interesting from its relation to these ancient Crustacea, are now most abundant in the seas of warm climates, chiefly in those of India, and on the coasts of America.

The following is the description of the species from the coal-measures, Bilboa Colliery, county of Carlow.

Steropis arcuatus, n. s.

Cephalic shield, semicircular or lunate, slightly arched, declining towards the circumference, and surrounded by a narrow margin which is destitute of spines at its anterior extremity; the central portion, head or

glabella, having three ridges extending to about two-thirds of the breadth of the shield, rounded at their anterior extremity, and forming corresponding depressions, the central ridge being broader at the posterior extremity, the two outermost ridges curving at about half their length towards the very slightly raised semicircular eyes, and continuing beyond the posterior extremity of the shield in two sharp, straight spines, which project over the abdomen one-tenth of an inch. The cephalic shield is also produced into a longer spine at the posterior angles, three-tenths of an inch in length, which spreads out on either side from the body. There appears to be a facial suture, commencing at the anterior margin, curving towards the eye, and forming a half circular lid, although it is not perceptible beyond this point. The abdominal and caudal extremities are wanting.

Size of cephalic shield, breadth, 7–10ths of an inch.
„ „ $3\frac{1}{2}$–10ths „

This species is closely allied, in the form of its cephalic shield, to *Limulus trilobitoides*, figured by Buckland in his "Bridgewater Treatise," Plate XLVI., Fig. 3; and by Prestwich on the "Geology of Coalbrookdale," in the "Geological Transactions of London," second series, vol. v., Plate XLI., Fig. 8.

Portlock, in his "Report on the Geology of Londonderry," &c., figures at Plate XXIV., Fig. 11, from carboniferous shale, Maghera, Derry, a specimen which he refers, although somewhat doubtful, to this species; his figure is destitute of spines, and certainly does not appear to bear much resemblance to the species in question.

There are, however, differences in the specimen under notice which are not exhibited in the figures before alluded to, sufficient to make it a new species. These consist in the two outermost ridges, defining the central part of the cephalic shield or head, being continued over the abdominal segments as spines, and in the great spreading out of the two longer spines at the posterior angles of the shield; as well as in possessing a distinct facial suture.

The great interest attached to this specimen is in the fact of the rare occurrence of remains of this genus in Ireland, and its evident affinity with similar forms of Crustacea from the lower coal-measures of Coalbrookdale, a formation believed to be of estuary origin, and described by Mr. Prestwich as consisting of alternating beds of sandstone and clay, the strata being between 700 and 800 feet thick, which has yielded between forty and fifty species of terrestrial plants, many species of Mollusca, besides fishes of the genera Megalichthys, Holoptychius, and others, as well as several species of the remarkable Crustacea before alluded to; the specimen now brought before your notice being also found, under somewhat similar conditions, associated with several species of plants and Mollusca.

The following species are now included in the new genus Steropis:—

Steropis arcuatus (*Baily*), *n. s.* Coal-measures, Bilboa Colliery, county of Carlow.

Steropis (*Limulus*) *anthrax* (*Prestwich*). "Geological Transactions," second series, 5, t. 41, Fig. 1–4.
,, ,, *rotundus*. Ibid., Fig. 5–7.
,, ,, *trilobitoides*. Ibid., Fig. 8; and Buckland's "Bridgewater Treatise," p. 396, t. 46, Fig. 3.
,, ,, *trilobitoides* (??). Portlock's "Report," t. 24, Fig. 11.

Synonyms of this Species.

Steropis (*Entomolithus monoculus*). Martin, "Pet. Derb.," t. 45, Fig. 4.
,, (*Bellinurus bellulus*). König, Icon. Sect., Pl. 18, No. 230.

The President stated that this was the first specimen of a Limulus found in those coal-measures.

Mr. Baily stated, in answer to the President, that only three heads had been found, and not the tail.

Professor Kinahan considered the absence of spines a strong confirmation of Mr. Baily's view as to separating these specimens into a new genus.

Mr. Kelly made some remarks.

The President then read the following letter—

ON THE ORIGIN OF MAGNESIAN LIMESTONE. BY CAPTAIN CHARLES P. MOLONY, OF THE MADRAS ARMY.

Various opinions have, from time to time, been put forward regarding the way in which magnesian limestone has been formed. Some say that it is a stratified magnesian limestone. Others deny this, and argue that it must have been formed by infiltration. Others, again, maintain that it was originally a stratified rock formed by the deposition of carbonate of lime, but that it was afterwards altered or changed into a magnesian limestone by the impregnation of magnesian vapours given off by neighbouring igneous rocks when in a heated state. Another party assert that it was at first deposited in regular strata of carbonate of lime, or the common gray limestone, but that, at a subsequent period, water, holding carbonate of magnesia in solution, passed over the rocks, which, having great absorbent powers, like lump sugar, drank in, in course of time, sufficient carbonate of magnesia from the water to change them into magnesian limestone.

Dr. Apjohn has clearly shown that the rock could not have inhaled magnesia from vapours given off by igneous rocks when in a molten or heated state, as magnesia is not capable of being vaporized.

The almost total absence of fossils in these rocks is also brought forward, "and with truth," as proof that they could not have been originally stratified rocks that were afterwards altered into magnesian limestone either by absorption or by impregnation; for, if they were, the animals that were embedded in the limestone strata at the time of their deposition would still remain in the rocks.

Thus it will be seen this subject is one that has occupied a good deal of attention, and has called forth the expression of various opinions regarding its formation.

One or two things regarding its possible, if not probable, formation have lately suggested themselves to the mind of the writer; and as they may, perhaps, throw some light on the subject, he would beg to offer them.

It is argued by many persons that the great paucity of fossil organic remains in all magnesian limestone rocks is proof that the carbonate of magnesia could not have been deposited contemporaneously with the carbonate of lime. Now, were great abundance of fossil exuviæ, or none at all, to be met with in these rocks, the circumstance might be claimed as pretty conclusive proof in favour of the above argument; but the fact of a *few* fossils only being *occasionally* found in them would appear to the writer to be strong evidence in support of the two carbonates having been deposited at the same time. Carbonate of magnesia may have been held in solution in one sea, and carbonate of lime in solution in another, and the one may have been conveyed to the other by means of currents, as will now be shown.

Mr. Maury, in his excellent work on the Physical Geography of the Sea, fully explains the theory of oceanic currents, their velocity, and power of transporting matter from one sea to another. It is difficult, he says, to form an adequate conception of the immense quantities of solid matter, in solution, which the current from the Atlantic carries into the Mediterranean; and he mentions the circumstance of several vessels having been detained in Almira Bay for three months, in consesequence of the strong currents between that place and Gibraltar, which swept them back whenever they tried to get out.

Now, suppose these currents, which baffled and beat back this fleet for so many days, ran no faster than two knots an hour, assuming its depth to be 400 feet only, and its width seven miles, and that it carried in with it the average proportion of solid matter ($\frac{1}{30}$) contained in sea-water, and admitting these postulates into calculation, it appears that salt enough to make no less than eighty-eight cubic miles of solid matter, of the density of water, were carried into the Mediterranean in these ninety days. Now, unless there were some escape for all this solid matter, which has been running into that sea, not for ninety days merely, but for ages, it is very clear that the Mediterranean would ere this have been a vat of very strong brine, or a bed of cubic crystals. It may be laid down as a rule, he goes on to say, that all the currents of the ocean owe their origin to difference of specific gravity between the sea-water at one place and the sea-water at another; for wherever there is such a difference, whether it may be owing to difference of temperature or difference of saltness, it is a difference that disturbs equilibrium; and currents are the consequence. The heavier water goes towards the lighter, and the lighter whence the heavier comes; for two fluids differing in specific gravity, and standing at the same level, can no more balance each other than unequal weights in opposite scales. It is immaterial whether

this difference of specific gravity be caused by temperature, by the matter held in solution, or by any other thing; the effect is the same, namely, a current.

Now, suppose one sea to have held carbonate of lime in solution, and a neighbouring sea, carbonate of magnesia, then, according to Maury's theory, a surface and under-current from one sea to the other must have been established, by reason of the difference of specific gravity of the two seas,—the specific gravity of magnesia being greater than that of lime; and these currents must have lasted so long as that difference existed, which may have been for thousands of years.

Thus carbonate of magnesia may have flowed into the one ocean, and carbonate of lime into the other, till equilibrium was set up between them, which would have occurred on the proportions having become one to one, or, in other words, when they had mingled together, and gained the ratio to form magnesian limestone; and then an age of tranquillity and subsidence may have commenced, during which the mixed carbonates may have been deposited at the bottom of the sea, and our dolomites and magnesian limestones have been formed.

It is well known, however, too, that at this moment an under-current is flowing in, and an upper-current running out of the Red Sea. That these currents are caused by other causes than the above is true, viz., evaporation; yet the theory is the same, and the result the same—namely, a current or currents, and the accumulation of vast quantities of solid matter.

Knowing, then, that these currents and counter-currents have been going on, almost unceasingly, in various parts of the world ever since we became acquainted with them, and that there is every probability of their doing so for ages to come,—may not the suspended matter and aqueous solutions of one sea have been carried into and become mixed up with those of another, and deposited there in regular strata, and fresh matter have been carried in day after day and year after year, for a continuation of ages, and have been thrown down upon that last formed.

Assuming, then, that such things possibly occurred, it would fully account for the absence of fossils in our magnesian limestone. Carbonate of magnesia being detrimental to vegetation and injurious to animal life, the Fauna of those seas that contained carbonate of lime, finding their provinces invaded by the influx of so dangerous an enemy, and driven from their old haunts by the noxious fluid, must naturally have sought refuge in other parts of the ocean more congenial to their habits and less fatal to their existence. But some few feeble and worn-out races, unable, perhaps, to accompany their friends, may have been engulfed in the magnesian solution, and not having sufficient strength to extricate themselves from it, may have been embedded in its deposits.

The PRESIDENT then communicated the following paper:—

ANALYSIS OF ANORTHITE FROM THE URAL MOUNTAINS. BY ROBERT H. SCOTT, A. B. T. C. D.

PROFESSOR G. ROSE having requested me to undertake the analysis of the Felspar of a Diorite which forms the Konschekowskoi Kamm, near Bogoslowsk, in the northern Ural Mountains, I accordingly did so, and found it to be Anorthite; the results of the analysis being:—

		O. ratio.	
Silica,	46·794	24·2969	
Alumina,	33·166	15·5028	17·6338
Peroxide of Iron,	3·043	2·1310	
Lime,	15·968	4·5408	
Magnesia,	trace.		4·9632
Potash,	0·554	0·0939	
Soda,	1·281	0·3285	
	100·806		

The specific gravity of the portion analyzed was 2·72. This mineral is granular, not exhibiting distinct crystalline faces, and is soluble in muriatic acid.

The second constituent of the Diorite, a greenish-black hornblende, has been analyzed by Professor Rammelsberg (Pogg. Ann. 1858, iv. p. 441). His analysis gives—

		O. ratio.
Titanic Acid,	1·01	
Fluorine,	0·25	
Silica,	44·24	22·97
Alumina,	8·85	4·13
Peroxide of Iron,	5·13	1·54
Protoxide of Iron,	11·80	2·62
Lime,	10·82	3·09
Magnesia,	13·46	5·38
Soda,	2·08	0·53
Potash,	0·24	0·04
Loss by ignition,	0·39	
	98·27	

The mineral has a specific gravity of 3·214. It is compact, with perfect cleavage.

The Diorite itself is very coarse-grained, the minerals being distributed through it in irregular masses. It contains also a little quartz, and some brownish-white mica.

The President stated that Mr. Scott's analysis confirmed his own analysis of Anorthite from the Carlingford Mountain.

The Society then adjourned to November.

DUBLIN NATURAL HISTORY SOCIETY.

FRIDAY EVENING, MARCH 5, 1858.

R. Callwell, Esq., M. R. I. A., in the Chair.

The previous Minutes having been read and confirmed,—

Professor Haughton exhibited specimens of Lepidomelane from the county of Donegal.

Professor Kinahan, M. D., read the following—

ON THE DISTRIBUTION OF FERNS IN IRELAND, WITH A LIST OF SOME OF THE MORE REMARKABLE LOCALITIES IN WHICH THEY OCCUR.

During the many years which have elapsed since the publication of Mackay's "Flora Hibernica," the ferns have received so much attention in the British Isles, and as a natural consequence the list of them has been so much increased by the discovery of unrecorded species, and the identification and discrimination of others, as to render the list of them given in that valuable book necessarily imperfect, and of comparatively little use to the student. Having been engaged, since 1848, myself, in their study, and had opportunities of collecting in almost every quarter of the island; and also having had, through the kindness of friends in England, opportunities of examining in a living state, authenticated specimens of all the disputed or critical species, I propose to print a list of the more important localities in which the several species have occurred.

To enumerate all the localities in which common ferns occur would swell the list to an inconvenient size. To such species as are of general occurrence, and equally abundant in suitable stations, the simple remark, "general," is appended; fuller details being given in the case of such species, as by their markedly special distribution, or peculiarity of growth in certain localities, seem to be of geologic value; the word 'geologic' here, and generally throughout this paper, being used, not in the confined sense of the class or character of rock or soil, on which the plants are found, but rather in the more extended and general sense—of distribution from a geologic centre of creation.

The districts examined by me are—

For the North, the counties of Tyrone, Fermanagh, Monaghan, and Armagh.

For the West and South-west, Galway, King's County, Clare, Westmeath, Queen's County, Kilkenny, Tipperary, Limerick, Kerry, Cork, and Waterford.

For the East and South-east, Louth, Meath, Dublin, Kildare, Carlow, Wicklow, Wexford, and Cavan.

There are no sufficiently marked features in the central counties to call for a separate division. I have not had an opportunity of examining the Far North, my researches not having been pursued further north than Tyrone. Wexford, in the South-east, I have never examined, but some years since a friend of mine, since dead, Thomas Barry, Esq., forwarded me a large collection of fresh fronds from this neighbourhood, which enabled me to learn that its Fern Flora much resembles that of the counties immediately adjoining. The stations examined by myself in the following list are either marked with my initials, or left unmarked. Those supplied from other sources are between inverted commas, the letters q. v. being added in cases in which I have seen the actual specimens.

Ophioglossum vulgatum (*Lin.*). Adder's Tongue.

Tipperary: Annagh Inch, along Little Brosna and Pallas Rivers. Kerry: Beginnish Island, Lough Kay, Valentia, J. R. K. Meath, G. A. Pollock, Esq. Dublin: Dodder Valley, Kilnasantan, J. R. K. "Wexford; Rathcormack," Thomas Barry, Esq., *q. v.*

Appears to be generally distributed in all parts of the island, having been recorded from near Belfast by Templeton; its small size, and capricious mode of growth, one year abundant, the next not to be found, probably accounts for its absence from so many of the local lists. It does not grow near so luxuriantly here as in England.

Botrychium lunaria (*Linn. sp.*). Moonwort.

"Tipperary: Clonmel," E. H. Sargint, Esq., *q. v.* "Louth," G. A. Pollock. "Kerry: Valentia Island," Miss Helen Blackburne. Dublin: Kilmashogue Hill. Here also grows a singular deltoid form (*vide* "Nat. Hist. Review," vol. iii., "Proceedings Nat. Hist. Society"): Kilnasantan and Cruagh Hills, J. R. K. Wicklow: Scalp, J. Bain, *q. v.*

The short period of this plant's appearance above ground, and the localities it frequents—open elevated pastures and heaths—doubtless contribute to render it rare in our lists. It has been obtained in the county Antrim, and grows as luxuriantly here as in England.

Osmunda regalis (*Linn.*). Royal Fern.

Galway. King's County: All Saints bog, rare. Clare: Lough-a-torrig, local. Kerry, common. Waterford: Portlaw, Ardmore. Wicklow: Devil's Glen, rare, J. R. K.

From the above, it will be seen to be generally distributed, though often local. It is most luxuriant in the west and south, especially near the sea, where a stunted form of it grows down often within the high tides line. In Dublin it is extremely rare. The only station I ever heard of, that given by Mackay, appears to be now extinct. I have often searched there unsuccessfully for it.

Blechnum spicant (*Linn. sp.*). Northern Hard Fern.

Common and general, growing alike in mountain range, and ele-

vated lowlands, and bog; it flourishes even amidst the sea spray in some localities. I have met it in every locality I have been in. A crisped subform of it is worthy of notice.

Pteris aquilina (*Linn.*). Common Brakes.

Common and general, but most affecting lowlands or sheltered glens.

Polypodium vulgare (*Linn.*). Common Polypody.

Common everywhere from lowland glade to the summit of our wildest hills. I have met it 1800 feet above the sea level, in the wild gorges of the county of Wicklow and county of Limerick, luxuriantly growing. The plant on the exposed ridges small and stunted, but wherever there is the smallest shelter, its growth is most luxuriant and beautiful.

Gymnocarpium phegopteris (*Linn.*). Beech Fern.

Kerry: Killarney, Torc mountain, very abundant. Wicklow: Waterfall, very scarce, J. R. K.

This fern has been recorded from Down and the north, generally; it is by no means so abundant here as in England.

Cystopteris fragilis (*Linn. sp.*). Bladder Fern.

Galway: Gort, J. R. K. Clare: Burren, J. R. K.

Though recorded from Wicklow and Dublin, careful research in this latter locality, and in many parts of Wicklow, has been unrewarded on my part. I have never met it except in the west and north-west, where it is tolerably abundant.

Polystichum aculeatum (*Linn. sp.?*). Broad Prickly Shield Fern.

Tyrone: near Aughnacloy, not rare. Monaghan: ditto. Galway: very common. Clare: Feakle, rare. Tipperary: near Birr, very rare. Kerry: rare, local. Dublin: very local and rare. Kildare: very abundant; Levitstown. Carlow: ditto. Queen's County, Maryborough, J. R. K.

I have been particular in noting the localities of this and the following species, as they are often confounded. It is an extremely local species, commonest in the south-west; it, as far as I can learn, frequents lowlands chiefly. In Dublin it is one of our rarest species. It would appear to be a plant of most peculiar growth, which, perhaps, accounts for its very disjointed distribution over the country. The form met near Feakle differs so much in character from the ordinary plant, that I have some hesitation in positively considering them identical, being much stunted and narrower in its form, and retaining this character in cultivation. It grows as luxuriantly in Galway as anywhere in Cheshire.

Polystichum angulare (*Wildenow sp.*). Angular Shield Fern.

Tyrone: Omagh, extremely rare. Aughnacloy: rare. Galway: abundant. Dublin: extremely abundant, J. R. K. Kerry: very abundant. Tipperary: Annagh Inch, local, scarce, J. R. K.

This species, unlike the last, is generally diffused and most abundant commonly; the county of Tyrone, at its northern extremity, is an exception. I could only find one plant near Omagh and at Aughnacloy; though the plant occurs, it is far, very far, from common or abundant; in fact, it appears to me to be less abundant in the north than in the east, where it is one of the most characteristic ferns. In west or south I have not thought it necessary to multiply localities.

Lastrea montana (*Vogler sp.*). Mountain Fern.

Tyrone: Gortin Gap, sparingly, 1857. Galway. Clare: Feakle, very abundant. Kerry: Killarney, scarce. Waterford: Clonmel, scarce. Dublin: Dodder Valley, local. Wicklow: Lough Breagh and Glendalough, J. R. K.

This fern is very local, but, for the most part, abundant where it occurs. It cannot, however, be called the common fern of any of the districts recorded except Clare; it is the inhabitant in that country of wild mountain sides, near Lough Graney. The deciduous growth of its fronds has, doubtless, caused it to be often overlooked. It appears to be commonest in the west.

Lophodium Fœnisecii (*Lowe sp.*). Bree's Fern.

Tyrone: Omagh, common. Monaghan: common. Galway: very common. Clare: abundant, but local. Tipperary: rare. Kerry: very common. Kilkenny: Piltown, common. Waterford: Curraghmore, very common. Dublin: extremely rare. Wicklow: Glendalough, very abundant; Sugarloaf, rare, J. R. K.

This well-marked species, as will be seen from the above list, is one of the most commonly diffused ferns in Ireland, being in fact a most characteristic plant of the west and south. On the other hand, in Dublin, and the counties more immediately adjacent thereto on the north-east, it is extremely rare. I know of but two localities in which it occurs in Dublin—Howth, and Glasavullawn, in the Dodder Valley.

Lophodium multiflorum (*Roth sp.*). Roth's Fern.

Generally diffused and abundant. It is one of the characteristic ferns of the east and north-east; especially in the bogs, replacing Bree's fern of the west.

Lophodium spinosum (*Roth sp.*). Withering's Fern.

"Monaghan: Dartrey, Rev. Mr. Lovatt Darbey; auct., Newman's British Ferns." Tipperary: bog drains, Annagh Inch, near Birr. Waterford: Curraghmore, Portlaw, 1858, J. R. K. I believe I also got this species near Cahirciveen, county of Kerry, 1856, J. R. K.

This species is certainly not common in Ireland. In the stations at Tipperary and Waterford it grows luxuriantly, but confined to a few stations.

Dryopteris affinis (*Fischer sp.*). Fischer's Fern.

General, and generally diffused, and always distinct from the next.

It grows most luxuriantly, and in a greater state of development at Beragh, county of Tyrone, than in any other locality in which I have met with it.

Dryopteris Borreri (*Newm.*). Borrer's Fern.

General, and generally diffused; affects more exposed stations and higher altitudes than the last.

These two species are among the more characteristic of the eastern species.

Athyrium filix fœmina (*Linn. sp.*). Lady Fern.

General, and generally diffused.

After a long and careful study of this, one of the loveliest of our native ferns, I cannot make out more than the one species of this fern in Ireland, of which forms at times occur which are identical, apparently, with *convexum*, *incisum*, and *molle* of the Floras. Whether the original types of these divisions were specifically distinct or not, I do not pretend to judge, but in Ireland we have but one species. I should except a small form (?) of this species, which I obtained some years ago at Ardmore, county of Waterford, growing on the sea cliffs, but which I have not had sufficient means of examining, to enable me to judge of its claims to specific distinction.

Asplenium lanceolatum (*Hudson*).

Cork: Kinsale, Mrs. J. Beete Jukes, 1856, *q. v*

The only Irish specimen I have ever seen was that noted above. I have recently seen the plant growing luxuriantly in Cornwall, near Polperro.

Asplenium adiantum-nigrum (*Linn.*). Maiden-hair Spleenwort.

General.

A commonly diffused, though local plant, occurs on rocks and earth-banks as its natural habitat; I have met it everywhere. In the north and east it is generally more local than in the south.

Asplenium acutum (*Bory MSS.*). Killarney Spleenwort.

Kerry: Torc Mountain and other places near Killarney, not uncommon, J. R. K., 1856.

No one who has seen this plant growing wild, or authentic specimens under cultivation, would for one moment entertain the idea of this and *Asplenium adiantum-nigrum* being the same species; their habits are distinct, and constantly distinct, so much so that I have known persons who were not botanists readily point out the difference between the two species. The confusion relative to the two has, I conceive, arisen from the fact of a form of *A. adiantum-nigrum* existing abundantly in various parts of the country; amongst others at Mucruss, Killarney, which is extremely difficult to distinguish from the *printed description* of this plant, but scarcely to be confounded with the plant itself. I have no

doubt the specimens examined by Professor G. J. Allman, and among which he found intermediate forms, fall under this category. The true plant was found by me abundantly, 1856, growing in clefts in the rock, and in dry stations generally; the plants generally single.

Asplenium marinum (*Linn.*). Sea-side Spleenwort.

General along sea-coast. Valentia Island, inland, at an elevation of 500 feet above sea, J. R. K., 1856.

As common in the east as the west, in favourable localities. I never went anywhere that I did not find it on the cliffs.

Asplenium trichomanes (*Linn.*). Maiden Hair Spleenwort.

General.

A local species, generally diffused; it is naturally a denizen of the clefts of bare rocks.

Amesium ruta muraria (*Linn. sp.*). Wall Rue.

General.

Universally distributed, though, from the peculiarity of its growth, local; it attains its highest development on rocks, and also on shady walls, in some cases covering these to the total exclusion of every other kind of vegetation.

Scolopendrium vulgare (*Linn. sp.*). Hart's Tongue.

General.

This species occurs all over the island, but most irregularly; in some stations in immense profusion; in others, seemingly as favourable to its growth, one or two stunted plants alone will occur. It is a characteristic eastern species, as in the county of Dublin.

Grammitis ceterach (*Linn. sp.*). Scaly Hart's Tongue.

Tyrone: near Cappagh. Galway: Gort, Burren. Clare: Tullagh. Kilkenny: road to Carrick. Tipperary: Lorrha, rare; Nenagh, common. Limerick. Kerry: near Valentia, rare. Waterford: Ardmore, on clay-slate, local. Dublin: Belgard to Saggart, abundant; Whitechurch, rare, (very local). Wicklow: Glendalough, Enniskerry. Queen's County, J. R. K.

A local fern, much more abundant in the west than in the east; it is very characteristic of the former districts.

Trichomanes radicans (*Swartz*). Killarney Fern.

"Limerick: Cumailte Mountains, on authority of specimens in Glasnevin Gardens." Kerry: Valentia Island (this locality first noted by Miss H. Blackburne), apparently introduced; Killarney, Torc mountain, very abundant, 1856, J. R. K. Waterford: "Glouin Caragh," W. Andrews, Esq., *q. v.;* Valley of Blackwater, 1852, J. R. K., very abundant. "Cork:" *vide* "Newman's British Ferns." "Wicklow:" 1805, auctore, "Mackay's Flora Hibernica."

I have been particular in noting the localities of this fern, as its

history and distribution are matters of great interest. A careful examination of the three localities noted above, viz., Waterford, Killarney, and Valentia, have convinced me that the form called "*Andrewsii*" after its discoverer, to whom also is due the identification of this plant with *radicans* of Swartz, is the normal form of the plant; the form which occurs at Killarney, and by which the plant is best known, having been drawn up by moisture, by which the parenchymatous portions of the plants are developed at the expense of the fructification. The plants at Waterford fruit freely, and are scarcely distinguishable from *Andrewsii*, but under cultivation many of them pass into the ordinary Killarney form.

Hymenophyllum Tunbridgense. Tunbridge Filmy Fern.

Clare: Monounta, Feakle, abundant on bare cliff, 500 feet high, J.R.K. Tipperary: Morgan's Glen, E. H. Sargint, Esq., mixed with next, *q. v.* Kerry: Valentia Island, rocks over Glenleavey woods, cliffs near slate quarries, sparingly; Killarney, abundant. Waterford: Glandine, sparingly; Portlaw; Curraghmore wood, abundant and fine, J. R. K.

This species has been confounded with the next; thus the stations given by authors at Glencree and the Waterfall, county of Wicklow, refer to next. I have never seen authentic specimens of this species except from the south and west.

Hymenophyllum unilaterale (*Wild*). Wilson's Filmy Fern.

Tyrone: Gortin Gap, abundant among rocks, 1857, J. R. K. "Tipperary: Morgan's Glen, E. H. Sargint, Esq.," *q. v.* Kerry: Valentia Island, near slate quarries, common. Killarney: very common, J. R. K. "Dublin: Kelly's Glen, W. Andrews, Esq." Wicklow: Waterfall, very abundant. Glencree: Greater Sugarloaf, scarce, J. R. K.

This species is most commonly diffused in the east and north, but grows more luxuriantly at Killarney than anywhere else that I have seen it.

The following Irish species have been recorded, and authentic specimens of them have been shown to me, but I have never been fortunate enough to meet them myself:—

Adiantum capillus-Veneris (*Linn.*). Maidenhair.

"Leitrim: Glencar," Right Hon. J. Wynne, *vide* "Natural History Review," page 69, vol. iv. Kerry: "Tralee, W. Andrews, Esq.," *q. v.* "Galway: Urrisbeg," W. M'Calla. "Clare: Ballyvaughan."

Polystichum lonchitis (*Linn.*). Holly Fern.

"Sligo: Benbulben," *q. v.* "Kerry: Brandon."

Hemestheum Thelypteris (*Linn. sp.*).

"Kerry: Killarney, Mucruss Demesne." Professor R. W. Smith, M.D., showed me an extensive living series of this plant from this, Mackay's original station, in 1856. "Mayo and Antrim."

Asplenium viride (*Hudson sp.*).

"Kerry: Torc Mountain, Killarney," 1856, *q. v.*

The following have been also recorded, but specimens gathered in Ireland have not come under my notice, with one exception:—

Cryptogramma crispa (*Linn. sp.*). Recorded from Down, Antrim, and Louth.

Gymnocarpium Dryopteris (*Linn. sp.*). Recorded from Antrim, Mr. D. Moore.

Lophodium rigidum (*Hoff*). Recorded from Louth by the Rev. Mr. Darby (*q. v.*): query, introduced plants?

The following species, natives of Great Britain, have not yet been recorded in Ireland, and, with the exception of the species queried (?), are not likely ever to be:—

Gymnocarpium Robertianum, *Woodsia Ilvensis*, *Woodsia Alpina*, *Cystopteris Dickieana*, *Cystopteris myrrhidifolium* (?), *Lophodium callipteris* (admitted into Dr. Mackay's list, as he himself has informed me, by an error), *Dryopteris abbreviata* (?) (I believe I met this at Omagh, but cannot yet speak positively), *Pseudathyrium Alpestre*, *Pseudathyrium flexile*, *Amesium Germanicum* (?), *Am. septentrionale;* and *Lophodium uliginosum* (pointed out to me living in the woods near Chisselhurst, Kent, by G. B. Wollaston, Esq.).

I have carefully abstained from admitting into this list any form of whose specific existence I am not convinced, such as *Asplenium anceps* (*Lowe*), first recorded from Killarney (where I have myself found it), by W. Andrews, Esq., and by him shown to be only a state of *A. trichomanes; Lophodium nanum*, extremely common on our mountains, but apparently only a state of *Lophodium multiflorum*, &c.

The nature of the soil or rock on which the plants grow is but of little moment; careful notes of the distribution and growth of the ferns in distinct geological districts would lead to the conclusion that the only influence thus exercised relates more to the amount of shelter, moisture, and depth of soil mechanically dependent on geological formation than to the chemical constituents of the rocks. Numerically speaking, the species of ferns found on the bare granite ranges of the county of Dublin are equal to those of the more favoured and sheltered limestone districts of the Burren, and this becomes more striking when we except those plants of Lusitanian origin which occur in the latter county. Yet in the Fern Flora of the several districts there are features sufficiently marked to be of importance in the investigation of the sources whence the plants came, certain species of ferns in the several districts being more abundant, and growing in greater luxuriance, than the remaining species in that district, or than they themselves are found in other districts.

Thus, excluding such generally diffused species as *Pteris aquilina* and *Asplenium marinum*, the characteristic ferns are as follows, in the several districts:—

Dublin: for the *Lowlands—Polystichum angulare, Scolopendrium vulgare, Dryopteris affinis, Asplenium trichomanes.* For the *Highlands* and *Bogs—Lophodium multiflorum, Athyrium filix fœmina, Dryopteris Borreri, Dryopteris affinis, Lomaria spicant, Asplenium adiantum-nigrum.*

Kildare: *Lowlands—Polystichum aculeatum, Polystichum angulare, Scolopendrium vulgare, Lophodium multiflorum, Dryopteris affinis, Athyrium filix fœmina.*

Tyrone: *Highlands—Athyrium filix fœmina, Lophodium Fœnesecii, Lophodium multiflorum, Hymenophyllum unilaterale. Lowlands—Polystichum aculeatum, Dryopteris Borreri, Dryopteris affinis.*

Clare and Galway: *Lowlands—Polystichum aculeatum, Polystichum angulare, Polypodium vulgare, Athyrium filix fœmina, Amesium ruta muraria, Grammitis ceterach, Lophodium Fœnesecii, Asplenium adiantum-nigrum. Highlands and Bogs—Lomaria spicant, Lastrea montana, Loph. multiflora, Asplenium trichomanes, Cystopteris fragilis, Osmunda regalis, Hymenophyllum Tunbridgense, Polypodium vulgare.*

Kerry: *Lowlands—Polypodium vulgare, Polystichum angulare, Loph. Fœnesecii, Dryopteris affinis, Dryopteris Borreri. Highlands and Bogs—Osmunda regalis, Hymenophyllum Tunbridgense, Hym. unilaterale, Trichomanes radicans, Hemestheum phegopteris, Polystichum angulare, Asplenium acutum.*

Waterford and Cork: *Lowlands—Scolopendrium vulgare, Polystichum angulare, Grammitis ceterach, Asplenium adiantum nigrum, Polypodium vulgare, Lophodium multiflorum. Highlands and Bogs—Lophodium Fœnesecii, Dryopteris affinis, Hymenophyllum Tunbridgense, Osmunda regalis.*

Besides these, in the following districts ferns of local distribution occur, but not abundantly enough to impress a general character on the Flora:—

In Kerry: *Asplenium acutum* and *viride*, and *Adiantum capillus-Veneris.* Cork: *Asplenium lanceolatum, Trichomanes radicans.* Waterford: *Trichomanes radicans, Lophodium spinosum.* Tipperary: *Lophodium spinosum.* Wicklow: *Trichomanes radicans, Hemestheum phegopteris.*

Of the Irish species, all, except *Asplenium acutum*, have occurred in England, but many grow more abundantly and luxuriantly in Ireland; while, as has been already shown, many of the British species are unknown in Ireland. These latter, we are justified in surmising, are either Germanic or Boreal types, as many of them on the coasts of Wales and Scotland are found flourishing in stations identical with some on this side of the channel, the narrow strait which severs the two islands alone dividing them, and the missing species so hardy in their habits, as, once introduced into this country, to have been able to stand the ordeal of our mildest winters and severest springs.

I would be inclined to look on such ferns as *Cryptogramma crispa, Asplenium viride,* and *Cystopteris fragilis,* as northern species, owing to their occurring rarely, or comparatively so, in this country as compared with England and Scotland; the first having probably been introduced into this island from England shortly previous to the severance of the countries, and having since then, owing to the change of climate, barely

languished out an existence,—this supposition being strengthened by the fact, that the Irish localities recorded for it are adjacent to, or at least in the same districts as those in which *Polystichum Lonchitis*, an undoubted boreal species, is found (the late Professor Smith, in his description of the Flora of the Alps, *vide* "Natural History Review," page 48, vol. iv., mentions his having remarked these ferns growing abundantly in juxtaposition at a considerable elevation).

Of the place of origin of *Trichomanes radicans* and *Asplenium acutum* there can be little doubt, Lusitanian is stamped on every fact connected with their distribution.

This view of the origin of *Trichomanes radicans* enables us to reconcile the seeming contradiction of its present and past distribution in the British Isles; for, looking at *L. Fœnesecii* as a member of the same Flora, that this is so is evident, since the district in which it is at present most characteristic and abundant also furnishes such confessedly Lusitanian types as *Erica ciliaris, E. Sibaldis, E. Mediterranea, Asplenium acutum, A. lanceolatum, Simethis bicolor, Pinguicula grandiflora*, &c., among plants; and among animals, *Bufo calamita, Helix pisana, Anthrocera minos* (?), *Geomalacus maculosus, Echinus lividus, Cossonus Tardii, Thia polita*, &c.,—forms sufficiently characteristic to mark the district as possessing a great Lusitanian colony, many of the species not occurring elsewhere in Ireland and in England, only in the southern counties.

Giving due weight to the difference of habit of growth,—Trichomanes requiring three to four years for the full development of its fructification, and *Loph. Fœnesecii* perfecting its spores in the course of a season; bearing in mind the different physical conditions under which these two species are *capable* of existing,—an examination of their present distribution furnishes at once the clue as to how Trichomanes could have ever occurred at Bellbank (Yorkshire), and Powerscourt (Wicklow). The following general laws of distribution explain the whole difficulty:—

I. A species having spread from its centre, that disturbing causes incompatible with its existence may arise at any point in the track of that distribution; the range of its existence may cease at this point, and the continuity of the distribution be destroyed, giving rise to a colony or colonies.

II. That this interruption of continuity may proceed even to the total destruction of the *capital centre*, the *colony* or colonies remaining in vigour, or at least existing subsequent to the destruction of the capital.

III. That the disturbing causes having been removed, and the range of existence being thus restored, the species may spread from this colonial centre or centres as from the capital, or even re-colonize the capital.

Let us examine in this point of view the recorded range of *Trich. radicans* and *Loph. Fœnesecii*. Trichomanes flourishes in a district extending from about 51° 30′ N. to 52° 40′ N. (Bantry being the most southern

recorded station, and Cumailte Mountains, county of Limerick, its most northern), and as far east as about 7° 50′ W., the Blackwater valley representing the latter; the plant growing in greatest perfection, that is, fruiting most regularly and perfectly at Iveragh, and in the valley of the Blackwater; the extreme humidity of the Killarney district, whilst encouraging the ordinary growth of the plant, interfering with its fruiting.

Outside this well-marked district are two outlying stations, both, at the time of their discovery, sickly, and now extinct, or at least one of them: one, Wicklow, situated in about 52° 10′ N. and 6° 20′ W.; the other, Bellbank, near Bingley, Yorkshire, about 53° 30′ N. and 1° 55′ W.

In all these districts *Lophod. Fœnesecii* is found luxuriant, but local in the latter two.

Suppose these two plants to have made their entry into Ireland somewhere in that district which *Asplenium lanceolatum*, *A. acutum*, *Adiantum capillus Veneris* mark out as the head-quarters of the Lusitanian Flora, and to have spread under favourable circumstances as far north as Yorkshire; that then, the two countries severed, the physical conditions of district were so altered as to destroy the balance necessary to the former's existence in the intervening districts. This favoured spot at Bingley, where Richardson gathered, one hundred and fifty years ago, the celebrated specimen which has so puzzled botanists, remained as the last haunt of *Trichomanes radicans;* whilst its hardier compatriot escaped the general destruction of Lusitanian forms so well as to supply us with abundant stations even much further north than this. Similarly the Wicklow station may be but an offset from that in the county of Waterford, and may be even anterior to it, the chain of continuity being broken by some causes which caused the disappearance, plant by plant and station by station, of *Trichomanes*, so that the sickly plant discovered by Dr. Whitley Stokes and Miss Fitton, in 1805, at Powerscourt Waterfall, at last alone remained to point out the old colonization of the district with the species.

Some explanation of the set of terms already freely used is necessary, viz., "balance necessary to the plant's existence." By this is meant those degrees of intensity of physical agencies, especially light, heat, and moisture, compatible with the existence of any species, or, as we might otherwise express it, the *physical range of its existence.* The following series of laws express this more generally :—

1. Every species requires light, heat, moisture, &c., for the due performance of its functions, and the quantity of these thus necessary may vary within certain fixed limits.
2. That this limited standard may be still further either increased or diminished within certain further limits, without destruction of the life of the species, though usually at the expense of or deterioration of some of the functions.
3. That the (1) standard of growth and (2) range of existence varies in species springing from the same centre.

Suppose two plants, species A and B, having the following *range of existence* and *standard of growth*,—

	Range of Existence.		Standard of Growth.	
	A.	B.	A.	B.
Light, . . .	50°– 10°	90°– 20°	40°– 20°	70°– 30°
Heat, . . .	120 – 30	120 – 10	100 – 70	100 – 30
Moisture, . .	200 – 70	170 – 10	150 – 80	110 – 20

Now it is manifest these two species, though capable of existing in the same district, are not uniformly so, but that one can exist in a district where the other must perish.

For instance, in a country whose average climate was represented by the following range, L, 80° – 10; H, 80° – 25; and M, 90° – 10; A would perish, except from a few favoured spots, and a slight further diminution of the standard would destroy it altogether; while B would suffer but slight inconvenience, but would be probably found least frequent in the very station most favourable to A. Substitute for A and B in the above, *Trichomanes radicans* and *Lophodium Fœnesecii*, and the reason of the persistence of the latter in districts in which the former has become extinct is evident, particularly if we remember the peculiar conditions, as regards light and moisture, requisite for the well-being of *Trichomanes*, and the perfect carelessness of *Loph. Fœnesecii* as regards these. It but needs the supposition of the destruction of the woods of a district by an elevation of the temperature, or any other cause; the light would at once mount up to a standard incompatible with the well-being of Trichomanes, which would then necessarily perish from every place, except a few limited localities, where sufficient shelter might be afforded it by rocky crannies, such as the Powerscourt station might afford, and here the species would languish out a feeble existence, while *Loph. Fœnesecii*, heedless of the increased light, would still flourish on.

One of the animal types, already mentioned, affords such strong corroboration of this theory that I cannot resist quoting it. *Helix pisana*, a Mollusc of South Europe, was found by Mr. W. Andrews at Iveragh, Kerry. Next it occurs in a lengthened strip along the coast of Dublin, Meath, and Louth, even as far south as Rush. Next it occurs at Tenby, about half a degree to the south of its Kerry station; and lastly, it is recorded from Cornwall, that favoured spot, where still flourish many confessedly Lusitanian forms. Let any one take the trouble of examining on the map the connexion between these localities, and compare with them the distribution already laid down for Trichomanes and *Lophodium Fœnesecii*, and he will perceive that the connexion between the two districts is too strongly marked to be merely accidental, but rather

such as bears me out in stating that the great Lusitanian life-tide once extended much further north than it at present does.

It would be easy, by means of these same laws, to demonstrate the causes of the local occurrence of many of the ferns in Ireland, but this paper has already extended to such a length that I must content myself with the following arrangement of centres to which the species appear to have belonged.

Lusitanian: *Asplenium acutum, Asplenium lanceolatum, Adiantum capillus-Veneris, Lophodium Fœnesecii, Lophodium* (?) *spinosum, Hymenophyllum Tunbridgense, Grammitis ceterach.* Sub-Lusitanian: *Asplenium trichomanes, Asplenium adiantum nigrum, Amesium ruta muraria.*

Germanic: *Ophioglossum vulgatum, Botrychium lunaria, Blechnum spicant, Pteris aquilina, Polypodium vulgare, Polystichum angulare, Lophodium* (?) *multiflorum, Athyrium filix fœmina, Asplenium marinum, Scolopendrium vulgare.*

Northern: *Gymnocarpium Phegopteris, Cystopteris fragilis, Polystichum Lonchitis, Cryptogramma crispa, Polystichum* (?) *aculeatum, Lastrea montana, Hemestheum* (?) *thelypteris, Gymnocarpium Dryopteris, Asplenium viride, Dryopteris affinis, Dryopteris Borreri.*

The above distribution will, perhaps, surprise many, especially the reference to the Germanic type (i. e. Germano-Indian continental type) of all our most generally diffused types; but finding these ferns equally distributed in Great Britain and Ireland, I am inclined to think they must have spread over the two countries at the time when the Germanic Fauna were introduced through England into this country: by sub-Lusitanian I mean types which, undoubtedly coming from the same centre, were introduced into this country before the restricted Lusitanian species made their appearance.

Professor Kinahan exhibited some very fine varieties of *Polypodium vulgare, Asplenium trichomanes,* and *Dryopteris affinis,* sent to him by H. A. Mandeville, Esq., of Anner House, Clonmel, by whom they had been obtained near Carrick-on-Suir. The first-named exhibited a great number of secondary axes sprung from the main axis, and was a fine example of the irregularity of outline sometimes assumed by Acrogens. Dr. Kinahan had never seen such fine specimens. The other two, though extremely interesting, were more common, and had occurred frequently to Dr. Kinahan.

Mr. J. Bain exhibited a fine example of a curious variety of *Athyrium filix fœmina*, from the county of Wicklow. It was characterized by the stunted growth of the pinnæ, and total abortion of the stalks of the pinnules, which gave it an appearance resembling somewhat that of *A. trichomanes.*

Dr. W. Frazer exhibited a curious pendant cup-shaped nest of *Vespa* —— ? attached to a twig. It was taken at the Dargle, county of Wicklow; but unfortunately the maker was not captured, which rendered it impossible to identify the species.

The following were declared duly elected:—

Ordinary Members:—R. J. Daniell, M. B., Baggot-street; John Lawler, Esq., Longford-terrace.

Corresponding Member:—Rev. H. H. Jones, Adare, county of Limerick.

Associate Member:—W. H. Bailey, Esq., Geological Survey of Ireland.

The Meeting then adjourned.

FRIDAY EVENING, APRIL 9, 1858.

Charles P. Croker, M.D., M.R.I.A., Vice-President, in the Chair.

The Minutes of the previous Meeting having been read and confirmed—

Mr. R. P. Williams exhibited a black-and-white variety of the field mouse (*Mus sylvaticus*), which had been presented to the Society by C. J. Walmeslie, Esq., whose attention was first called to the specimen in question by the fact of its being possessed of the power of producing a chirping noise. Instances of these so-called "singing mice" had already been noticed on several occasions, the so-called song being, probably, dependent on disease in the animal. Varieties of this species as to colour were rare in the wild state.

The Rev. Professor Haughton communicated the occurrence of Lepidomelane in the county of Carlow; specimens having been forwarded to him from Ballyellen, by Charles P. Cotton, Esq.

Mr. William Andrews, Honorary Secretary, read the following—

NOTES ON THE FISHES OF THE WESTERN COASTS, AND RECORD OF THE OCCURRENCE OF THE BOAR-FISH (C. APROS) IN THE IRISH SEAS.

As other objects of interest new to the marine zoology of Ireland are to be brought forward this evening, I shall be as concise as possible in selecting from the many notes which I have made regarding the deep-water animals of the west coast, especially the fishes.

The existence on the west coast of Ireland of botanical and zoological types similar to those of the shores of Cornwall and Devon, and of Spain, Portugal, and the Mediterranean, has often afforded subject-matter for the meetings of this Society. It has been supposed that currents setting from the southward, and here mingling, have raised the temperature of the water, and carried to these shores the denizens of those around the Tagus and Mediterranean. It is known to nautical men that a stream more or less perceptible, and termed Rennel's Current, has had the effect of carrying ships out of their course to the northward, when seeking to make the Cape from the Western Ocean; but it has

never been satisfactorily proved that the temperature of this coast is due to any current, nor are we justified in attributing to it the occurrence of the interesting plants and animals which have from time to time occurred here.

A comparison of the geographical position of these coasts with the shores of Cornwall leads us to expect similar species of plants and animals, while the mild and moist atmosphere caused by the prevalence of the westerly winds maintains a temperature which permits the growth throughout our western hills of plants peculiar to the sub-alpine districts of Spain and Portugal. The beautiful sea-pea (*L. maritimum*) is of far more luxuriant habits and robust growth at its only Irish habitat, Rosbegh, at the south-eastern extremity of Dingle Bay, than in the pebbly beaches of Lincolnshire and Suffolk, and in Shetland; and, according to the late Dr. Graham, of Edinburgh, is identical with the plant of the south of Europe. Many of the Lichens and Algæ of these shores are identical with those of the south-west of England and of the Mediterranean.

With regard to the fishes, many species found in Cornwall and the Mediterranean have been also met with on our south-western coasts, the announcers of their occurrence in too many cases recording them as "visitors." In all branches of the fisheries which I have been able to investigate, I have ever found facts condemnatory of the erroneous idea of the migration of fishes; and wherever the captures already alluded to have been made, there was the established region of the fishes' existence. In the distribution of marine animals locality may often affect a species as regards its abundance, greater development in size, or perfection in type; but wherever we have met with individual instances of the occurrence of rare species, we may rest assured that the locality is, to a certain extent, either greater or less favourable to their existence. Our observations must be, indeed, limited, such slender opportunities are and have been afforded to us of examining and exploring the haunts of the deep-water marine fishes; and we can venture to put forward but imperfect views at present with regard to the investigation into the nature, habits, and extent of existence of such animals.

In the collections made from time to time in trawling and other investigations of the coasts, I have often proved how essentially important it is to note accurately the localities and habits of the various fish and other marine animals,—peculiar soundings affecting the habits, character, and quality of many species of fish. In colour and character of species many of the Triglæ, or Gurnard family, obtained in Dingle and Ballinskellig Bays, are identical with, or approach more nearly to the same species from the Mediterranean than to specimens from the southern seas. It is many years since I called attention to the occurrence here of the supposed species *Trigla Blochii*, and of a species in character identical with *Trigla pini* (*Bloch*).

Although we have some representatives on this coast of fish of the northern regions, such as *Cottus Grœnlandicus*, *Sebastes Norvegicus*, *Morrhua minuta*, and *Raniceps trifurcata*, all supposed at present to be of

great rarity; yet the principal species are those occurring also on the south-west coast of England and in the Mediterranean. Among these may be mentioned—

Lemon Sole, *Solea pegusa* (*Yarrell*).
Variegated Sole, *Monochirus variegatus*.
Solenette, *M. linguatulus*.
Rock Sole (unrecorded species).
Scaldfish, *Rhombus arnoglossus*.
Mackerel Midge, *Motella glauca*.
Two-spotted Goby, *Gobius bipunctatus*.
Little ditto, *G. minutus*.
Speckled ditto, *G. reticulatus*.
Red Mullet, *Mullus surmulettus*.

All taken, in deep water, in Dingle Bay, and off Ventry Harbour.

Black Bream, *Cantharus griseus*.
Spanish Mackerel, *Scomber celias*. A specimen of this, weighing 3 lbs., having been taken in a herring-net, was sent to me.
Stone basse, *Polyprion cernium*.
Comber Wrasse, *Labrus comber*.
Red ditto, *L. trimaculatus*.
,, *Crenilabrus microstoma*.
Rainbow Wrasse, *Julis Mediterranea*.

I have the pleasure to-night of bringing forward another addition to the Ichthyology of Ireland,—a fish peculiarly Mediterranean,—the boar-fish, *Capros aper* of Lacep. and Risso, *Zeus aper* of Linnæus. This little fish, *Perca pusilla* (*Brunnich*), so remarkable for its beauty and rarity, was taken in a trawl off Ventry Harbour, in soundings of fine soft sand, and was secured for me through the vigilance of one of the most experienced and intelligent of the Dingle fishermen, Mr. Eugene Moriarty.

Whenever anything remarkable has been obtained, and in the ground of the most valuable marketable fish, the soundings, &c., are duly recorded. Thus, off Ventry the bearings are:—Old Man, opening in the Sound of the Blaskets, bearing N. W.; the Eastern White House at Ventry, a sail's-breadth open of the west point, bearing N. E. by N.; the eastern point of the Bay open of Minard Point, bearing E. by S. 27 fathoms, fine sand. Standing in:—Ventry houses, opening of the west point; Minard, touching Bull Head; Mount Eagle, on the western point of Ventry, bearing N. N. W. 20 fathoms, fine soft sand; closer in, Crow Rock, in with the tower of Bing-Bong Head, bearing E. half N.; Minard Point shut in.

These were the grounds of many of the fish that I have submitted to your notice, and the locality of the capture of the present.

On reference to the several books of British ichthyology, there appear only to be two records of the capture of the *Capros aper* on the coasts of England,—one taken in Mount's Bay, coast of Cornwall, in October, 1825; the other obtained in the Bridgewater fish-market, in April,

1833,—and this is the first record of its capture on the Irish coasts. In its recent state it presents a beautiful appearance. The peculiarity of its projecting snout, its oval and compressed body, shaded on the back with a rich brownish carmine, of a brighter and more reddish colour on the sides, and silvery towards the abdomen; the body hispid, covered with minute and rough scales, beautifully ciliated on the margin; the mouth with very minute teeth, and very protractile, similar to the Doree; eyes very large, pupil a dark plum colour, the irides a rich pink; the first dorsal very strong and spinous, as also the ventrals; the membranous and emarginate rays of the dorsal of a yellowish tinge; pre-operculum finely serrated. About six and a quarter inches in length from the snout to the extremity of the caudal fin, and the body in depth three inches; the dorsal-fin rays are continuous, the first having very strong spines.

It is allied to the Zeinæ, or Dories, and is evidently a ground-feeding fish, and a deep-water species. Like the Doree, its mouth is protractile, and capable of much expansion, favouring the capture of soft and minute animals that may float in its way; for, like the Equuleus, a noted little fish of the Indian Ocean, it can suddenly form a tube-like projection of its mouth. Its eyes, which are brilliant, are very large for the size of the fish, and are such as seem peculiar to fishes feeding at considerable depths, and which are seen in the genera Platysomus and Blepharis, of the same sub-family.

Professor J. Reay Greene then brought forward the following—

ADDITIONS TO THE IRISH FAUNA.

The first of these was an apparently new species of Brittle-Star, allied to the *Ophiocoma neglecta* of Forbes, from which species it differed in the shape and convexity of its disk, which presented, moreover, a cleft and emarginate appearance opposite the insertion of each of the rays; in the pair of heart-shaped plates, situated within the margin of the disk, by which the rays were subtended; in the shape of the upper ray plates, which were of a somewhat transversely ovate form; in the number of spines (three or four on each side), with which the lateral ray plates were provided; and lastly, in the relative proportion (1 : 4) between diameter of the disk and the length of the rays. For this Brittle-Star he would suggest the name of *Amphiura Leachii.*

The second addition which he wished to record was a species of sea-anemone, the *Bunodes gemmacea* of Gosse, hitherto unknown on the Irish coast, though extremely abundant on the shores of Devonshire and other parts of England. On the outside of Cork Harbour it seemed to be equally common.

Another species of Bunodes, which he supposed to be new, had likewise occurred to him, as also a peculiar form of Lucernaria (*vide* "Proceedings of the Dublin University Zoological and Botanical Association," March 19, 1858).

He had also met with that very remarkable and beautiful stalked Polyzoon, the *Pedicellina Belgica* of Van Beneden. Of this he had examined two living specimens, both growing upon fronds of Laminaria. On the same fronds were several cells of *Gemellaria loriculata*, a common English Polyzoon, of which, strangely enough, no Irish habitat has yet been recorded. The figure of Johnston, drawn probably from a dead specimen, represents the cells as too much flattened.

All the above were taken between tide-marks on the sea-shore near Trabulgan, county of Cork, opposite the residence of Lord Fermoy. Here, too, he had also captured a single young specimen of the comparatively rare *Uraster hispida.*

Dr. E. Percival Wright called the attention of the Meeting to the Polyzoa noticed to-night. It showed the necessity which existed for thoroughly examining this group in Ireland.

Professor Kinahan, M. D., exhibited a fine specimen of *Polyporus gigantea*, measuring nearly two feet in thickness; the layers of which it was composed covered an extent of surface of nearly two feet by nine inches. It was attached to a stem of whitethorn (*Cratægus oxyacantha*), and had been found in the breast of a ditch near Portlaw, county of Waterford. He was indebted for the specimen to Miss H. Shaw, of Springfield, Portlaw. The specimen illustrated the irregular mode of the plant's growth, and its perennial nature, in a remarkable manner. Dr. Kinahan alluded to the great abundance and luxuriance of fungi, mosses, and lichens, in and about Curraghmore, county of Waterford, where he had also found *Lophodium spinosum* growing in some abundance.

The Meeting adjourned to the month of May.

FRIDAY EVENING, MAY 7, 1858.

Professor W. H. Harvey, M.D., M.R.I.A., F.L.S., President, in the Chair.

The Minutes of the previous Meeting were read and confirmed.

Dr. Kinahan read the following recommendation of the Council:—

"That Robert John Montgomery, Esq., be appointed as Honorary Director of the Museum, the Director to be *ex-officio* on the Council."

Moved by Dr. Kinahan, seconded by J. I. Whitty, LL. D., and unanimously resolved,—That this recommendation of the Council be adopted by the Society.

Rev. Eugene O'Meara read the following paper—

ON THE OCCURRENCE OF ANTHOZOIDS IN PLEUROSIGMA SPENCERII.

On Friday evening, April 30, I was engaged in the examination of a gathering I had made two days previous from a running stream.

On looking into the microscope I was much struck with the peculiar appearance of one of the forms that first presented itself in the field,—a *Pleurosigma Spencerii*. The usual colour of the endrochrome in this species is pale brown, but in the present instance it was a beautiful green. A number of granules of a bluish-green colour were distributed through the cell. In a few minutes I observed that the greater portion of the granules, at least two-thirds, moved with a sudden jerk to the lower part of the cell. Some of the granules passed out of the valve, and immediately after an Anthozoid issued from the cell. Shortly after another made its appearance, and another, until six or eight had been extruded.

All these organisms proceeded in the same manner from the valve, and exhibited themselves in the same spot, within what appeared, under a quarter-inch objective, with No. 2 eye-piece, about $\frac{1}{16}$th of an inch from the extremity of the valve. In form the Anthozoids, if at rest, would have presented very much the appearance of a spike of thistle-down. The head was of a pale green colour, and round it the tail was lashed from side to side with great activity.

On the same occasion several forms were observed, presenting similar appearances, with Anthozoids moving rapidly about in their immediate neighbourhood. Among these were two or three of the species named *Cymatopleura solea;* but in no case except the one just alluded to did I observe them issuing from the valve.

On the evening following that in which the preceding observation was made, I examined a drop from the same gathering, when a great change was noticed to have taken place in the appearance of such diatomaceous forms as occurred, compared with that which they presented the evening before. But few granules were seen. The endochrome also had changed its colour from green to olive, and, instead of being diffused through the cell, was in many instances collected in a narrow band along each side of the cell, or at the opposite ends of it. In some cases these bands had broken up into isolated portions, and in others the valve was as free from endochrome as if it had been treated with acid.

The President dwelt on the value of the observation, which was, he believed, perfectly new, and he had no doubt, as such, would be controverted, or at least probably received with doubt. There was, therefore, the more necessity for repeating the observation, and, if possible, confirming it. He thought it most probable that these bodies were Zoospores, and not Anthozoids; though this would not in the least detract from the value of the observation. Perhaps Mr. William Archer, who had devoted so much time to the study of the Desmidiæ and other simple vegetable forms, would favour them with his views on the subject.

Mr. Archer said that he felt inclined to look on these bodies as Zoospores, as suggested by Professor Harvey, otherwise we must suppose that two forms of the same mode of reproduction (that by dissimilar cells) existed among these plants. The observation was, nevertheless, a most valuable one.

PROFESSOR KINAHAN, M. D., read a paper—

ON THE GENERA PHILOSCIA (LATREILLE); ITEA (KOCH); PHILOUGRIA (KINAHAN); COMPRISING DESCRIPTIONS OF NEW BRITISH SPECIES.

(WITH A PLATE.)

IN an "Analysis of the British Oniscoidea" read before Section D of the British Association, at their recent Meeting in this city, and afterwards published in your Transactions, reasons were given for re-establishing the genus *Philoscia* (*Latreille*), which M. Edwards, Dana, and others, are inclined to incorporate with the genus Oniscus. As first described, the genus included but one species, the *Oniscus muscorum* (*Scopoli*), *Oniscus sylvestris* (*Fabricius*). To-night I have to announce another species of the genus, which confirms me in the propriety of the establishment of this genus, as it agrees with *Phil. muscorum* in all those characters which led to the generic separation of that species from Oniscus.

The genus Philoscia, though established by Latreille, appears to have been unknown to all the German authors who have written on the group, with the exception of Zaddach, who gives a very fair description of it. H. Schæffer states:—"Philoscia: Up to this, but one figured species is known, namely, *O. muscorum* (*Scopoli*). Whether the species *O. sylvestris* here cited is properly referred here may be questioned; to me the genus and species is unknown." Milne Edwards contents himself with copying Leach's description of the species; while Lereboullet evidently has never seen the typical species, as he describes a well-marked species of Oniscus for it. This is singular, as the animal is one of the commonest of the group in Ireland and England, and, Zaddach states, also common in some parts of Germany.

The genus Philoscia and its relations were so fully discussed in my former paper, that it is unnecessary here to do more than briefly describe the species and genus.

Family.—PHILOSCIDÆ.

Genus 1.—PHILOSCIA (*Latreille*).

Telson (cingulum ultimum) coxis perparvulis. Pleopoda (pedes spurii) posteriora nuda, ad *telson* marginem exteriorem articulata, basis quadrilateralis; *Ischium* trigonum, satis appendiculatum, nudum, lobus accessorius triangularis. Antennæ internæ 3-articulatæ. Antenn. extern. basis rotundatus, non lobatus; filamentum 3-articulatum. Abdominis cingulûm coxæ parvæ. Carapacis frons nec medianè nec lateralitèr lobatus.

1.—*Philoscia muscorum* (*Latreille*).

Corpore læve, nitido, splendido. Fronte paululum medio arcuato. Telson late-triangulari, apice acuminato, lateribus rectis. Pleopodis posterioribus; *Ischio*, falciformi; Appendice ischii dimidio longitudinem vix superante.

Sub musco lapidibusque ubique abundantissime, etiam ad littus marinum.

2.—*Philoscia Couchii, n. s.*

Corpore læve, splendido. Fronte recto. Telson lineare-triangulari; apice obtuse-truncato, setis validis armato; lateribus paululum excavatis. Pleopodis posterioribus; Ischio falciformi-subulato. Appendice vix $\frac{1}{4}$ ischii longitudinem æquante.

Sub lapidibus algisque marcescentibus ad maris marginem ad "Talland Cove," juxta Polperro, Cornwall, Angliam hæc species a me reperta fuit. Viro clarissimo Jonathan Couch, F. L. S., qui de animalibus marinis regionis Cornubiensis cognoscendis optime meruit, dicatam esse velim.

PHILOSCIA.

Body flattened; no lateral or median lobes to carapace; internal antennæ three-jointed. Peduncle of external antennæ rounded, unlobed. Tige three-jointed. Posterior pleopods (last pair of false feet) attached to exterior margin of telson, uncovered. Peduncle (basis) quadrilateral. Ischium trigonal, and, as well as accessory appendage, uncovered.

Species 1.—*Philoscia muscorum* (*Latreille*).

Body smooth and shining; head transversely elliptical, arched in front; no true lateral or median lobes; internal antennæ inconspicuous; external antennæ densely hairy; abdomen much narrower than cephalothorax; telson (last ring) broadly triangular; apex acute; posterior pleopods (abdominal false feet); Ischium trigonal, spinous along edges. Accessory appendages more than half length of ischium, and nearly attaining to its summit.

Colour: fulvous, with dark black patches and white blotches. A pale salmon-coloured variety is not uncommon. Habitat: dry places, under leaves, stones, moss; also near sea-shore very common.

Habits: runs rapidly; seeks sunshine; does not roll into a ball; feigns death.

Localities: Dublin, Wicklow, Meath, Wexford, Cork, Waterford, Tyrone, and probably all over Ireland. England—Middlesex, Essex, Kent, Plymouth, Devonshire not so common, Cornwall, Polperro, &c.

Species 2.—*Philoscia Couchii* (*Mihi*) *n. s.* Plate XXIII., Fig. 4.

Body smooth, elliptical; head somewhat rounded, nearly straight across front; beneath orbits a small lobe, arising from superior margin of antennal ring. Internal antennæ inconspicuous; external antennæ hairy; tige long and narrow. Abdomen narrower than cephalo-thorax. Telson (last ring) narrow, linearly triangular; apex rounded, and fringed with stiff bristles; sides excavate. Posterior pleopods (last pair abdominal feet); ischium elongate, falciform, subulate. Accessory appendage scarcely one-fourth the length of ischium; in other respects as *Philoscia muscorum*.

Colour: lead gray, uniform to the naked eye.

Habitat: under stones, and amid decaying sea-weed at high-water mark; local.

Habits: runs with great agility; does not roll.

Locality: Talland Cove, Cornwall, 1858.

I have named it after Jonathan Couch, M. D., F. L. S., the well-known illustrator of Cornish zoology.

The only species I can at all find described which comes near my *Philoscia Couchii* are two figured in Dana's great work as Onisci: one, *O. nigrescens*, from New Zealand; the other, *O. pubescens*, from South America. Dana evidently was unacquainted with the genus (as I have before shown) as distinct from Oniscus.

In the new species the frontal border of carapace is carried well forward, and passes down to the antennæ, the superior antennal ring having its margin produced into a minute lobe beneath the orbit. This species fully proves the judiciousness of the separation of Philoscia from Oniscus.

In the same paper I also proposed the foundation of a new genus, Philougria, for the reception of a small Oniscoid, which is extremely common, but which, undescribed in this country, was also apparently undescribed on the Continent; at the time I stated my suspicions that the genus Itea of Koch had been misdescribed; but, owing to want of proper figures, I did not feel justified in identifying my specimens, to which I gave the name of *Philougria celer*, with the *Itea riparia* of Koch, for I found the genus described by Koch as having only one joint in the tige of the antennæ, and even Zaddach, who has noted and corrected this error, and has given an admirably accurate description of two species, used such terms as these:—"Antennæ interiores magis etiam diminuta quam in Philoscia ex *uno modo articulo constare* videntur:" a description which any one who examines the description of *Philougria rosea* of this present paper will find to be most incorrect; the antennæ in that species projecting so far beyond the front as to be visible to the unassisted eye from above.

During the past summer I was fortunate enough to meet with two other species of the same genus, which are identical with two out of the four species already described as Itea by Koch and Zaddach; and by help of these it appears to me that we are justified in assuming that both Zaddach and Koch erred in regard to the characters of the internal antennæ. The genus Itea being, then, inaccurately described, and furthermore the name having been long ago appropriated to a well-known genus of plants by Linnæus, I would suggest that the generic name suggested by me last year should still stand, and the name Itea be altogether erased from the carcinological lists; the only species of it which does not come into the present genus being the *Itea crassicornis* of Koch, which is seemingly a Platyarthus of Brandt. The examination of the two additional species obliges me to modify some of the minor characters of the genus, as published in my analysis, and the abolition of the generic term Itea necessitates the substitution of Philougridæ for Iteadæ as the name of the family. This, as it now stands, includes *Trichoniscus* (*Brandt*), should this genus prove distinct.

Family.—PHILOUGRIDÆ.

Genus 1.—Trichoniscus (*Brandt*).

Genus 2.—Philougria (*Kinahan*).
Itea (*Koch*) (in part).

Telson coxæ perparvulæ. Pleopoda posteriora nuda, in sinu marginis exterioris telson articulata; basis triangularis; ischium appendiculatum, trigone-subulatum; lobus accessorius satis magnus. Anten. extern. 3 articulatæ. Antenn. extern. pedunculum non lobatum; filamentum subulatum, 5 articulatum læve, filo abeuns. Cingulûm abdominis coxæ, primi parvæ, 2di, 3tii, 4ti, 5tique lineares. Carapacis frons nec medianè nec lateralitèr lobatus. Antennarum superiarum cingulum infra oculos lobo abeuns. (*Ph. riparia, Ph. rosea, Ph. vivida.*)

1.—*Philougria riparia* (*Koch, sp.*) Plate XXIII., Fig. 1.

Corpore lævi, splendido, elliptico. Antenn. intern. parvulis inconspicuis. Antennis externis ut *genus*. Telson supra pleopod. posterior. maxime excavato, truncato-triangulari, *apice emarginato*.

Sub musco, frondibus, lapidibusque ubique in locis madidis totam per Hiberniam et Angliam, hæc species, dispersa esse, videtur, rarius in Comitatibus meridionalibus.

Longitudo, ·15 unc.

2.—*Philougria vivida* (*Koch, sp.*).

Corpore lævi, splendido, *ovali*. Telson truncatè-triangulato; apice pæne recto, *superne profunde sulcato*, non emarginato.

Colore: fusco subtilissime albide-maculato.

Sub musco, lapidibusque in collibus ad "Portlaw, Com. Waterford," Hiberniam, non rare inveniam.

Longitudo, ·25 unc.

3.—*Philougria rosea* (*Koch, sp.*).

Corpore scabro, tuberculato. Oculis minutis. Antennis internis, conspicuis, ante frontem extendentibus. Abdominis cingulis, 1mo, 2do, 3tioque, granulatis; 4to, 5toque lævibus. Telson lateribus excavatis, apice truncato, recto; cæteris ut *Phil. riparia*.

Colore miniaceo-rubro, albido suffuso, aut albo. Longitudo, ·15 unc.

In horto, cellariisque, ad Plymouth, Com. Devon, Angliam, amicus meus Car. Spence Bate, F. L. S., hanc speciem observavit, ubi etiam non rarius egomet inveni.

Philougria (*Kinahan*), *Itea* (*Koch, in part*).

Body flattened; no lateral or median lobes to the front; internal antennæ three-jointed; external antennæ, second articulation rounded, unlobed; tige subulate, five-jointed, smooth; posterior pleopods completely uncovered, articulated in a notch at posterior margin of telson. Peduncle (basis) triangular, appendiculate; Ischium trigonal, smooth,

generally terminating in a set of filaments. Accessory appendage well marked.

1.—*Philougria riparia* (*Koch, sp.*). Plate XXIII., Fig. 1.

Synonyms: *Itea riparia* (*Koch*), *Itea lævis* (?) (*Zaddach*), *Philougria celer* (*Kinahan, olim*).

Body smooth and shining, elliptical; head oval; antennal plate attaining to frontal line, its external angles produced as small lobes beneath the orbits; internal antennæ small and inconspicuous; external antennæ of moderate length, carried folded at an angle. Telson deeply excavate over insertion of posterior pleopods, medianly produced, truncately triangular, deeply emarginate.

Length, ·15 inch.

Colour: uniform claret-brown; under the lens, most exquisitely marbled with white.

Habits: runs with great agility; buries itself deep in the earth; very impatient of drought; feigns death, but does not even semi-roll. I have found it with ova and young in the months of February to November.

Habitat: very moist places, among decaying vegetable matter, at roots of trees; under moss everywhere.

Localities: Dublin (Wexford, Cork, Kerry, E. P. W.), Tyrone; Waterford; Portlaw, rather rare; Kilkenny; Wicklow; Queen's County. England:—London; Kent; Plymouth, not so common; Polperro, Cornwall, not uncommon.

The young (?) specimens have the head slightly scabrous. A number of fine hairs (visible under an inch glass) are scattered over the rings.

The elliptical outline of the entire animal, its smaller size, the characters of the telson and of the skin (Plate XXIII., Fig. 1 *f*), which here is without pits, distinguish it from *Ph. vivida*, with which it might be confounded.

2.—*Philougria vivida* (*Koch, sp.*).

Syn.—*Itea vivida* (*Koch*), *Itea nana* (*Koch* (?), *Junior*). Plate XXIII., Fig. 2.

Body smooth, shining, oval. Telson truncately triangular; the apex nearly straight, deeply furrowed above, but not emarginate. Posterior pleopods and ischium trigono-subulate.

Colour: Claret-brown; under the lens, marbled with white.

Length: ·25 inch.

Habits: runs with great agility; does not bury itself; less impatient of moisture than *Ph. riparia.*

Habitat: under stones and amidst moss on the high grounds.

Locality: hills and high ground, about Portlaw, county of Waterford, where I met this species in great abundance in March, 1858, even in the midst of snow.

The superior size and the robust rotundity of this species distin-

guish it at a glance from *Phil. riparia.* Other characteristics are afforded by the form of the telson, which is only seemingly emarginate at the tip; and by the integument, which in this species is covered with a series of small pits (Plate XXIII., Fig. 2 *f*). The habits and favourite localities of the two are very distinct.

Koch founded the species on specimens brought from Vienna by M. Jenisson; the exact locality unknown. *Itea nana,* which appears to differ only in colour, was from the same collection.

PHILOUGRIA ROSEA (*Koch*). Plate XXIII., Fig. 3.

Synonym :—*Itea rosea* (*Koch*).

Body, except posterior abdominal rings, tuberculated; eyes very small, black, and conspicuous; internal antennæ very conspicuous, extending beyond front; lateral angles of antennal ring strongly marked beneath orbits; telson plane above, apex rounded, with four (?) strong bristles; external antennæ hairy; cephalo-thoracic rings and head coarsely granulated, the granules each bearing a bristle; abdominal rings, first to third granulated; fourth, fifth, and telson smooth.

Colour: clear minium-rose, with white dots, and a white stripe down the median line, or a dead white with a dark median line.

Length ·15 inch.

Habits much the same as the rest of the group; seems to be more humid in its haunts; does not roll; feigns death; and is not quite as active as either of the other species.

Habitat: in damp places, in gardens and courts, and in dark cellars (the pure white variety).

Localities: the first specimen of this species I saw was taken at Plymouth by my friend C. Spence Bate, F. L. S., in his cellar. On a further search there and in his court-yard I found the species abundantly. I never met it elsewhere.

For the drawings of this and the other species I am indebted to my friend Charles Spence Bate, F. L. S.

Koch states that the species is not common in Germany. *Itea Mengii,* of Zaddach, which at one time I was inclined to look on as this species, I am now rather inclined to identify with specimens which I have obtained in Donnybrook, and which, though differing from *Ph. riparia* in the following points—head scabrous; cephalo-thoracic rings covered with rough granulations, abdomen nearly same width as cephalo-thorax; telson not emarginate; colour, white, with dark stripes—I still hesitate to separate from that species of which I suspect they are the young state.

The only terms used in this Paper, additional to those in the Analysis, are—*telson* (last abdominal ring), and *posterior pleopoda* (last pair of appendages), both of which I have adopted from Spence Bate's Report on the British Amphipoda, at the same time wishing to guard myself from being supposed to have adopted the idea that there are three primary divisions of the crustacean body, viz., kephalon (head), pereion (thorax), pleon (abdomen). I cannot satisfy myself that in the type Crustacea of

twenty-one rings we have more than two primary divisions, viz., fourteen anterior rings (cephalo-thorax), seven posterior rings (abdomen). In some genera and groups we find (as Amphipoda) the first of these split up secondarily into two parts, and here it doubtless is convenient to name each of the parts. Used in this subordinate sense, the terms head, cephalon (or what I conceive means the same thing), *carapace* (as correctly used), and pereion, or thorax, may be used. Abdomen and pleon are confessedly identical—the only objection to the former term being, that it has been used to express an organ among the Vertebrata, an objection which, perhaps, after all does not signify much. The appendages of the segments, however, much need distinctive names, and there can be no objection to those suggested in the Report alluded to. Telson, in the same manner, appears to be an organ which is constant in its relations, and a most important one, specifically speaking, among the Isopoda.

I would suggest the following alterations in the sequence of the families of Oniscoidea as given in the Analysis:—

Tylidæ, Actæcidæ, Porcellionidæ, Oniscidæ, Philoscidæ (Philoscia, Scyphax), Philougridæ, Titanethidæ (Titanethes, Styloniscus, Ligidium), Ligidæ.

DESCRIPTION OF PLATE XXIII.

Fig. 1. *Philougria riparia* magnified:—1 *b*, posterior pleopod; 1 *f*, microscopic appearance of integument.

Fig. 2. *Phil. vivida*:—2 *d*, posterior pleopod; 2 *c*, inferior view of antennæ; 1 *e* and 2 *e*, internal antenna; 2 *f*, integument.

Fig. 3. *Phil. rosea*:—3 *b*, telson and posterior pleopod; 3 *c*, inferior view of head; 3 *f*, integument.

Fig. 4. *Philoscia Couchii*:—4 *b*, telson and posterior pleopod; 4 *d*, posterior pleopod.

The President declared the following gentlemen duly elected:—

Honorary Member.—Charles Spence Bate, F. L. S., Plymouth.
Corresponding Member.—James Martin, M. D., Portlaw.
Associate Member.—Robert Ball, Esq., T. C. D.
Ordinary Members.—John M'Ilwaine, Esq., Dublin; M. Weld O'Connor, Esq., Dublin; Robert Samuel Reeves, Esq., Dublin.

The Meeting then adjourned to the month of June.

FRIDAY EVENING, JUNE 4, 1858.

Charles P. Croker, M. D., M. R. I. A., Vice-President, in the Chair.

The previous Minutes having been read and signed,—

Mr. J. B. Doyle read the following paper—

ON SOME PECULIARITIES OF HABIT IN THE DODDER PLANT (CUSCUTA EPITHYMUM).

It is well known to botanists that there is a curious group of plants known by the name of *Parasites,* which derive the whole or the greater portion of their nutriment from other plants. Some of these, as the misletoe, have leaves of their own, and others, as the Dodder, have none, but only naked filaments, studded in the season with small tufts of flowers of a delicate pinkish-white. It is believed by some that there is a corresponding difference in their mode of feeding, the former having leaves of its own, feeding upon the ascending or unelaborated; the latter upon the descending or perfected sap.

Having spent some weeks, last summer, in South Devon, I paid a visit to Dartmoor Forest, and spent some very pleasant hours botanizing over the Moor.

In the course of my ramble my attention was arrested by the strange appearance of the gorse or furze, which at a little distance appeared to have a delicate pinkish hue pervading its green and prickly branches. Upon close examination I found that this was occasioned by the intermingling of a vast number of naked filaments or tendrils, studded with most elegant little waxy flowers, of a delicate French white colour.

A botanical friend explained that this curious plant was the *Cuscuta epithymum,* or Dodder plant.

To those who, for the first time, recognise a plant or specimen which they had previously known only from description, I need not describe the pleasure with which I examined this curious, very beautiful, but very mischievous little plant.

But my attention was soon arrested by a curious and, I believe, a very interesting discovery. Upon one of the specimens I observed two blossoms of the moor heath (*E. cinerea*) in vigorous health, growing upon a filament of the Dodder.

Upon closely examining the immediate locality, I found a stool of heath within less than a yard of the furze bush, from which I took the specimen now on the table.

There could be no doubt that the blossoms in question had been excised from the heath by the tendrils of the Dodder, and so completely were they incorporated that they did not miss their removal from the parent bush, but appeared to be nourished by the juices of the intrusive plant, and thus presented the novel feature of being a parasite in turn upon the true parasite which had borne them off.

The most curious part of the circumstance was that the Dodder, having excised the two pretty heath flowers, went forward on its rambles, throwing its lasso round a spray of the furze bush, striking into it fresh rootlets to support itself on its devious way, carrying intact its precious burden through the thorny maze.

I submit the fact for the consideration of the Society, leaving it for them to determine the interesting question as to whether the heath flowers were in reality nourished and bloomed by the juices of the Dodder, or only kept alive by the moisture of its succulent tendrils.

I trust I may be excused for bringing this circumstance under the notice of the Society. If the "Rape of the Lock" was a sufficient theme for Pope, surely a naturalist may be excused for noticing the abduction of this pretty little flower by one of the wild denizens of Dartmoor, especially as the robber is the more worthy of consideration, from the care he took of his beautiful protege.

Professor Kinahan, M.D., read a paper—

ON THE GENUS SCORPIONURA (J. V. THOMPSON, MSS.).

In the fourth volume of the "Natural History of Ireland," by W. Thompson, are recorded, by name only, three species of decapodous Crustacea, under the names of *Scorpionura vulgaris*, *Scorp. maxima*, and *Scorp. longicornis*. No description of this genus having been ever published, it is a matter of some moment to identify the species thus named, and which now exist in the collection of the Royal Dublin Society. I, therefore, gladly avail myself of the kind permission of our Honorary Member, Charles Spence Bate, F. L. S., to lay before you to-night the results to which he has arrived on examination of these specimens, and at the same time beg to record a locality for one of the species in the neighbourhood of Dublin. I prefer this course to myself drawing up any description of the species, as Mr. Spence Bate has already so thoroughly studied the family (the Diastylidæ), to which these species are referable, as to render it presumptuous on my part to offer any remarks on the structure of the animals.

My object in this communication is confined to proving, through the identification of these specimens, that the genus thus named by the late J. V. Thompson must be erased from our lists, the species composing it falling under the following genera:—Diastylis (*Say*), Cyrianassa (*Sp. Bate*), and a new genus for which Mr. Spence Bate suggests the name of Vaunthompsonia. At one time Mr. Spence Bate thought of retaining the name Scorpionura for this last genus; but that name being already pre-occupied, he has thought it better to call the genus after the discoverer of the Irish species.

It is extremely interesting to find among this collection—probably among the great haul made on the 28th April, 1823—several specimens of females with ova, showing that their observer was aware of these being adult forms, and adding another to the species recorded by Spence Bate as bearing this strong proof of these being mature, and not, as has been stated by some of our best authorities, the zoes of some of the Macroura. I have extracted Mr. Bate's communication and figures *in extenso* from the "Journal of the Royal Dublin Society," before whose evening meeting of the 28th May it was read.

DIASTYLIS RATHKII (*Kr. sp.*). SCORPIONURA VULGARIS (*J. V. Th. MSS.*)
ALAUNA ROSTRATA (*Goodsir*). CUMA RATHKII (*Kroyer*).

Dublin: near Skerries, by the late Robert Ball, LL. D. (*vide* Thompson's "Natural History," vol. iv., p. 392); Newcastle, Co. Down (W.

Thompson). I have not verified this last. South of Ireland (J. V. Thompson).

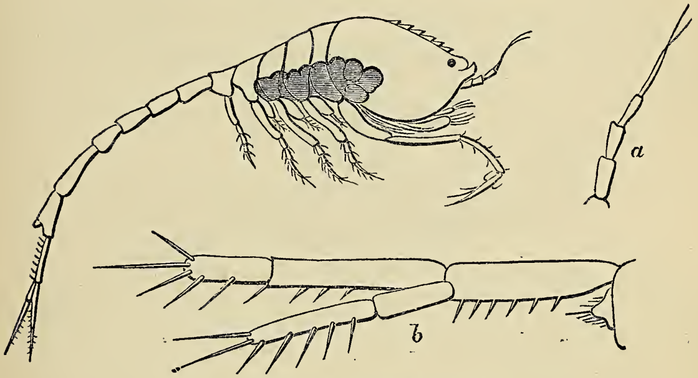
"VAUNTHOMPSONIA (*Spence Bate*).

"Carapax angulos laterales ante oculos convenientes. Antennæ superiores nullæ. *Pereii* segmenta quinque posteriora carapace nuda. *Pleopoda* pare ultimo excepto, absunt. *Telson* perparvulum.

"The lateral angles of the carapax meeting before the eyes; upper antennæ wanting; five posterior segments of the *pereion* (thorax) not covered by the carapax; all the pleopoda, the last pair excepted, absent; telson rudimentary.

"VAUNTHOMPSONIA CRISTATA (*Sp. Bate*).

"SCORPIONURA VULGARIS (*J. V. Thompson*).



a, antenna; *b*, posterior pleopod.

"Carapacis regione dorsali medio cristato, denticulato.

"The anterior portion of the central dorsal region of the carapace with a ridge of minute teeth; lower antennæ, four joints, the last a filamentary appendage; posterior pleopoda, with their rami unequally two-jointed, as long as the peduncle, and armed with stout spines arranged chiefly along the inner margin; telson triangular, squamiferous, ciliated.

"Length ·25 inch.

"The figure and description are from a female carrying ova; there are several specimens in the collection, two of them with ova.

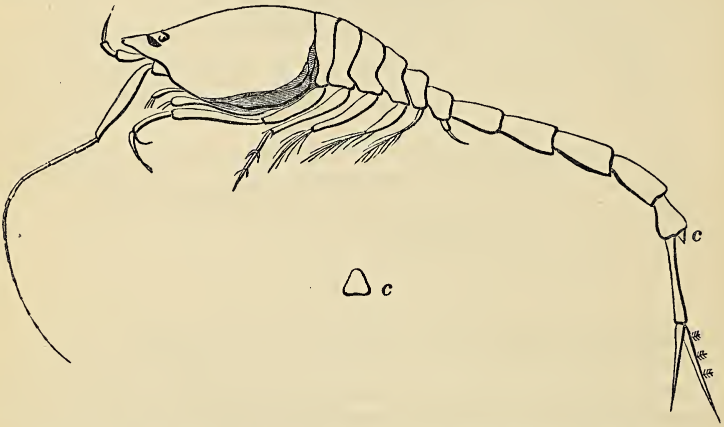
"This species approximates nearer to *Cuma Edwardsii* (*Kroyer*) than to any other I am acquainted with. It probably forms with it, as suggested in my memoir on the British Diastylidæ 'Annals, Nat. Hist.,' 1856), a genus distinct from Cuma, and which may be readily distinguished by the character of the *five* segments of the *pereion* being perfectly developed posterior to the carapace, whereas in Cuma there are but *four* thus developed.

"Although I have not had an opportunity of dissecting a typical species of the genus Cuma, I do not hesitate to group the present species, and probably *C. Edwardsii*, as distinct from Cuma, since Goodsir asserts that both antennæ are present in those Cumæ which he examined, the upper in a rudimentary state, a character which I cannot find in *V. cristata;* this, taken with the altered condition of the *pereion,* justifies the presumption of a generic distinction.

"In selecting a name, I have fixed on that of the discoverer, being one which is familiar to every carcinologist, and to which honour is due for valuable discoveries in this department of zoology. More than one of the name having been eminent as a naturalist, a license has been taken,—the Christian name has been incorporated with the surname, and both spelled according to sound: the word is thus both shortened and rendered more easy for pronunciation by foreigners.

"CYRIANASSA LONGICORNIS (*J. V. Thompson, MSS. sp.*).

"Pleopodis, paribus primo et sexto exceptis, nullis. Ceteris ut *Cyr. gracilis.*



"No pleopoda developed on the second, third, fourth, and fifth segments; the other characters as *C. gracilis.*

"All the appendages of the pleon are suppressed, except the first and sixth pairs; telson squamiform and rudimentary.

"Length, ·15 inch.

"In the higher forms of Crustacea the pleopoda in the male are often altered in form, and sometimes even wanting, except when they are subservient to the sexual character. It may be, therefore, that the difference between the present species and *C. gracilis* is one of sex only.

"A single specimen in the Royal Dublin Society's collection is the only one I have seen.

"The specimen is shorter and more robust than *C. gracilis;* the segments are brought closer together; the dorsal line of the *kephalon* and *pereion* is more arched; the antepenultimate joints of the lower antennæ do not extend beyond the anterior margin of the carapace. I have, therefore, thought it advisable for the present to retain Thompson's name, rather than absorb the species into that previously described. Having seen but a single specimen of each, I have not had the advantage of dissection to compare their separate details."—*On a New Genus and new Species of Diastylidæ, by C. Spence Bate, F. L. S.:* Journal of the Royal Dublin Society, vol. ii.

Other members of the group have occurred on the coast of Galway to Professor Melville, which I hope may be also brought at some future period before your Society.

Mr. Stephen M. Yeates exhibited a beautiful modification of the gas microscope, showing its applicability to illustration of microscopic preparations, as, owing to modifications in the structure of the instruments, it is possible, at a very slight expense, to exhibit to an audience objects which require high magnifying powers. Specimens of Arachnodiscus, and dissections of many insects, were distinctly shown. Photographs taken from objects by means of the instrument were also exhibited.

The Chairman declared Mr. William Laughrin, of Polperro, duly elected a Corresponding Member.

The Society then adjourned to November.

[NOTE *on Pandalus Jeffreysii* (*Spence Bate*), *and Pandalus Leptorhyncus* (*Kinahan*).—A critical examination of *Pandalus Jeffreysii*, through the kindness of its discoverer, has proved to me that the species of Æsop prawn found by me at Sandycove, and recorded in the December Meeting of the Natural History Society (*vide ante*), is distinct. The name *P. leptorhynchus* must, therefore, as suggested provisionally, be applied to the new species, *P. Jeffreysii* not yet being recorded as Irish.—J. R. KINAHAN, M. D., *June* 8, 1858.]

ROYAL IRISH ACADEMY.

MONDAY, APRIL 12, 1858.

JOHN KELLS INGRAM, LL. D., VICE-PRESIDENT, in the Chair.

REV. CHARLES B. GIBSON, Edmund T. Palmer, and Thomas Brooke, Esqrs., were elected Members of the Academy.

The CHAIRMAN read the following Address, presented on the 19th of March last, to his Excellency the Earl of EGLINTON and WINTON, Lord Lieutenant, &c. &c., of Ireland:—

"May it please your Excellency,—In my own name as President, and in that of the Council and Members of the Royal Irish Academy who accompany me, I have solicited this interview with your Excellency, for the purpose of presenting to you our respectful congratulations on your arrival in Dublin, to occupy for the second time the high and responsible office of Lord Lieutenant of Ireland. Your Excellency's former residence amongst us has made you acquainted with the literary and scientific institutions of this city; and it is therefore unnecessary for us to inform you that the Royal Irish Academy has been incorporated, and has laboured for more than seventy years, to promote the study of science, *belles lettres*, and the antiquities of Ireland. We trust that we are not guilty of any presumption when we express our conviction that the institution of this Academy has been eminently useful to Ireland. It has fostered and rewarded the pursuit of science and sound learning; it has brought together on a common ground men who have differed widely on political and religious questions, and the meetings of the Academy have ever exhibited that mutual forbearance and good will which are necessary for the calm discussion of scientific questions, and morally so desirable in this country. We have established, principally from the private contributions of our members and the liberality of individual donors, a Museum of Irish Antiquities, which has now acquired some reputation as illustrating the manners and customs of the nations that formed one of the great waves of migration of the human race. We have recently published a Descriptive Catalogue of one of the departments of this Museum, with a view to make its contents known to the learned of Great Britain and of Europe, and the immediate completion of the work is only delayed by the limited funds at our disposal. We have formed also a Library, to which her Majesty's Government has lately made some very valuable donations, by giving us the topographical and antiquarian materials collected for the Ordnance Survey of Ireland, and more recently some duplicate volumes of very useful newspapers and important Parliamentary papers removed from the Irish Office in London. Our Library consists chiefly of the transactions of sister scientific Academies—British and foreign—and of such books and manuscripts as relate particularly to the history, the literature, and the antiquities of Ireland. All Members can borrow books from our Library, and it is open, with necessary restrictions, to all who are properly introduced. By our Charter your Excellency is appointed, *ex officio*, the Visitor of the Royal Irish Academy, and we trust you will find leisure from your more important and higher duties to relax occasionally by doing us the honour of attending some of our meetings, and examining the remains of ancient Irish art and literature which are preserved in our Museum and Library. We beg to express our anxious hope that the period of your Excellency's administration in Ireland may prove an era distinguished by the promotion of peace and prosperity, the development of the industrial resources of the country, and the advancement of those literary and scientific pursuits to which the Royal Irish Academy is more especially devoted."

His Excellency returned the following reply:—

"GENTLEMEN,—It gives me much pleasure to meet a deputation from so distinguished a body, and to receive your congratulations on my re-appointment to the government of Ireland. The years that have passed since I was in Dublin have not driven from my recollection the history of your Society, or the knowledge of the beneficial effect which such a Society as yours has in promoting scientific attainments, not only in the city, but over the whole country. Any institution or any pursuit which brings together with a common or a praiseworthy object men who differ in religion and political questions is well worthy of support; and as I am by my official position the Visitor of your Academy, I hope I may have an occasional opportunity of relaxing and improving my mind by a glance at the curiosities which you have amassed."

JOHN R. KINAHAN, M. D., read the following paper—

ON OLDHAMIA, A GENUS OF CAMBRIAN FOSSILS.

IN certain schistose beds of the Cambrian series, as seen at Bray Head and other places in the county of Wicklow, and at Howth in the county of Dublin, are found masses of peculiar markings, which the eye readily recognises as casts of an animal belonging either to the Polyzoan or Hydrozoan alliance. Although at first sight there may, especially to an untutored eye, appear to be some resemblance between these markings, and the multiform shapes which masses of crystal assume, yet a consideration of their symmetrical regularity of form, their constancy of direction with regard to the bedding, their frequent occurrence and permanency of character in even dissimilar beds, situate at great distances from each other; their association with traces of the remains of animals of aquatic habits; and their close agreement in form with beings living at the present day,—lead us to dismiss as untenable every theory which would assign to them aught save an organized origin. Geologists of the present day, without hesitation, admit Oldhamia—as the genus founded for the reception of these fossils, in 1848, by Edward Forbes is called, in honour of Professor Oldham, who first noticed their existence in 1844 (*vide* "Proceedings of the Geological Society of Dublin," vol. iii., p. 66)—among the list of fossils. But, although the former animal nature of these beings is now admitted, their exact position in the scale is by no means free from doubt; nor need we wonder at this when we recollect that but a few years since the two great families—to both of which Oldhamia has been referred by different observers, viz., the Polyzoan Mollusca and the Hydrozoan Acrita—were confounded together, and that in many cases (widely different as the animals composing these two classes are in the structure and relations of their organs), even among recent species it is impossible *à priori* to declare, from the skeletons

Fig. 1.

alone, whether we have a Polyzoan or a Sertularian under examination, and we are only able to solve the question by reference to the soft parts of the animals. The only author who has, as far as I can learn, written on the subject, whose opinion is worth any attention, is the late Professor E. Forbes, and if I venture to differ from his published opinions, it is because my conclusions are based on a careful study of the rocks and fossils, on a more extended scale than had been made by him. At the same time I freely admit that it is extremely difficult to adduce any arguments in favour of the Hydrozoan nature of these fossils which will appear conclusive on paper, this conclusion being the result of a careful consideration and comparison of such details of structure as the fossils afford, and based on characters of a general nature, drawn from appearances, even tangible enough to the eye, but utterly impossible to be described with precision. I cannot discover or appreciate what the characters are which lead Professor Forbes, "speaking of their possible Polyzoan nature," to use the words, an alliance more in accordance with the minute structure; careful casts, taken from *Old. antiqua* and from specimens of *Sertularia argentea* imbedded in plaster, are so much alike, that some years since they would certainly have been pronounced not merely generically, but even specifically, identical.

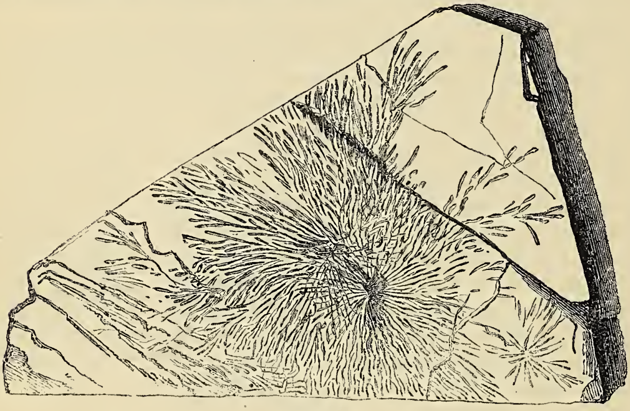


Fig. 2.

Two distinct forms at least of these fossils exist, both of which were named by Professor E. Forbes, and have been described somewhat at length by me in a paper read before the Geological Society of this city (*vide* "Proc.," vol. viii.). They differ so much that I almost question the convenience of associating them under the same genus, one (Fig. 1) being furnished with a distinct axis, from either side of which alternately ranged branches proceed at regular intervals (*O. antiqua*), whilst the other (Fig. 2) is destitute of any axis, made up of many stems of irregular length, springing from a common point, so that the fossils flattened from above present the form of a star, more or less regular ac-

cording as the axes are equal in length or not. Some of these are so irregular, however, that the radial character is almost lost, and they might be taken for another species; but I think specimens sufficiently intermediate in character exist to refute this view. There is no difference in the mode of the occurrence of these species,—masses of the animals compressed together in layers and intermingled in the beds of what evidently once was sandy mud. Occasionally we find scattered fans of *O. antiqua*, or single stems of *O. radiata*, and sometimes we get the whole mass so compressed and confused as to render it impossible to make out the parts distinctly. The species are generally found apart. I possess one specimen a quarter of an inch thick, in which a bed of *O. radiata* overlies a bed of *O. antiqua*, so that the specimen exhibits the two species on its opposite sides, and I have found scattered fans of *O. antiqua* among *O. radiata*. It would appear, then, that the two species lived under different circumstances, and had thus remained distinct even after death, just as at the present day we will find two distinct species of a group inhabiting the same seas at different epochs, the conditions which fit it for the existence of the one not being compatible with the well-being of the other. There is a form of *O. radiata* (?) which might be easily mistaken, on hasty examination, for *O. antiqua*, a mistake I have seen occurring even in museum collections. It appears to be formed by the overlapping of a number of the tufts of *O. radiata* in an alternate manner; but the absence of the rachis distinguishes it at once. Sometimes we find the same form much drawn out and elongated. This, sometimes at least, is due to the distortion dependent on cleavage; but in other specimens it is a genuine character dependent on the mode of growth of the Polypidom itself, a form of development familiar to every zoophytologist. The cells in which these animals dwelt appear to have been in *O. antiqua* biserial and alternate; in some specimens of *O. radiata* a similar arrangement is remarkably evident, but in others belonging to the second form described, and in which the termination of each of the axes is enlarged, this arrangement is not so evident. Springing from the axils of these cells in one or two of my specimens of *O. radiata* are somewhat elliptical bodies, which, although not strongly marked, are, I think, sufficiently so to satisfy me in considering them as oviferous capsules; I have not detected these organs in *O. antiqua*. One form of *O. radiata* presents the appearance of long, unbranched axes. This is an appearance also well known among recent Hydrozoa.

These are the more important points I have been enabled to make out regarding this genus as established by Forbes, and, taking into consideration the close approximation, almost amounting to identity in form, which exists between these and the Sertularia, their mode of growth, as far as we can judge, and place of occurrence, being so similar,—so much so that a superficial examination would lead one to pronounce them identical,—I think we are justified in considering these rather Sertularian Polypidoms than Polyzoan Cænæcia,—a view of the genus which, I am convinced, further research among living forms will eventually prove to be the correct one.

G. Johnstone Stoney, A. M., read the following—

NOTES ON THE MOLECULAR CONSTITUTION OF MATTER. NO. I.

The extraordinary power of the general method in Mechanics which we owe to the genius of Lagrange has tempted several mathematicians to try its strength in studying the unknown forces which enter into the molecular constitution of matter. In the applications of this method which have been hitherto made, as well as in other mathematical investigations into molecular forces,* the body under consideration has been supposed in its usual condition to consist of molecules:—

1°. At rest—

2°. Resembling one another, and similarly placed, each acting on its neighbours within a certain range—

3°. By forces adequately represented by functions multiplying the masses of the attracted and attracting molecules—

And which are such that the action on any one molecule may be represented by integrals extended through the sphere of action. In order that these integrations may be legitimate, it is necessary—

4°. That the sphere of action round each molecule include an immense number of other molecules, no one of which contributes more than an infinitesimal part to the total action on the central one; and—

5°. That the contributions from any two consecutive molecules be almost undistinguishable either in direction or amount.†

These hypotheses involve some remarkable results, the examination of which will enable us to limit the area of our search in prosecuting the study of molecular physics.

I°. Conceive a medium of uniform density within a closed space, and possessing a constitution fulfilling the conditions required by these hy-

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* See Cauchy: "Sur l' équilibre et le mouvement d'un Système de points matériels sollicités par des forces d' attraction ou de repulsion mutuelle."—Couchy's *Exercises de Mathematiques*, tom. iii., p. 202; and "De la Pression ou Tension dans un Système de points materiels."—*Ib.*, p. 224. Navier: "Sur les lois du mouvement des fluides."—*Memoires de l'Institut*, tom. vi., p. 389; and "Sur les lois de l'équilibre et du mouvement des corps solides élastiques."—*Ib.*, tom. vii., p. 375. Poisson: "Sur les équations générales de l'équilibre et du mouvement des corps solides élastiques et des fluides."—*Journal de l'Ecole Polytechnique*, Cahier xx., p. 1. Haughton: "On the Equilibrium and Motion of Solid and Fluid Bodies."—*Trans. Royal Irish Academy*, vol. xxi., part 2. Jellett: "On the Equilibrium and Motion of an Elastic Solid."—*Ib.*, vol. xii., part 3.

† The last two hypotheses, which must be insisted on if the method of integration be adopted, exclude many continuous functions; thus, using F to denote the mutual action of two molecules, and r for the interval between them, if the law of force be such that r^2F becomes infinite for $r=0$, the central elements of the integral will contribute unduly to it, so that such a value as—

$$F=\mu\frac{a^2}{r^2}\left\{1-A\frac{a}{r}+B\frac{a^2}{r^2}-\&c.\right\},$$

where μ is the coefficient of gravity, A, B, &c., constants, and a a line of fixed length, is not admissible if the method of integration be retained; yet this law, and others like it, would, it is evident, lead to several of the most obvious properties of matter.

potheses. Conceive within this medium a canal of finite and uniform section which returns into itself. There will then be nothing to prevent the part of the medium which is within this canal from yielding to any force tending to make it glide lengthways. It is evident from hypotheses (4) and (5) that no obstacle to this motion will arise from the molecular forces acting on the superficial portions of the canal, and, *à fortiori*, that none will arise from those acting farther within it. Hence, the medium is a fluid.

II°. Again, conceive the medium within the closed space to consist of two parts of different densities in contact with one another. Then, in order that it may be capable of retaining a constitution such as is supposed, the molecular forces must be such as will make the part of greater density diffuse into the other. For the sphere of action round some molecules will consist of two segments of unequal density. Now, a segment of the greater density must exert either a greater attraction on the central molecule than an equal and similarly situated segment of less density or a greater repulsion. For if it exerted neither, it would follow, from hypotheses (3), (4), and (5), that the density might be increased or decreased to any extent without opposition from the molecular forces,—a state of things wholly unknown in nature. Again, it cannot have a greater attraction; for it would follow that, even if the conditions at the surface of a uniform medium could be such as to establish a state of equilibrium, this equilibrium could only be unstable; so that on the most trifling inequality of density occasioned by a deranging cause, the parts of less density would flow into those of greater; so that the whole medium would ultimately collapse into one or more points, or until some forces not consistent with the hypotheses came into play; or else it would get into a state of permanent internal motion inconsistent with hypothesis (1). The only remaining alternative,* that the segment of greater density exercises a greater *repulsion*, leads to no such impossible results. It might only require the parts of greater density to flow towards those of less, and thus make a state of uniform density one of stable equilibrium with a pressure against the containing vessel. Hence the medium is an *elastic* fluid or a gas.

III°. Next let the medium be of uniform density within a closed space, and imagine any plane crossing this space; then the pressure per square inch of the part of the medium lying on one side of this plane against the part lying on the other side may be seen to be a function of the density as follows:—Let m be a molecule sufficiently near to the plane on one side to be within the range of molecular repulsion of particles lying at the other side, and describe round m a sphere including all the molecules which act on it. Part of this sphere will, therefore, lie beyond the plane, and from hypotheses (3), (4), and (5), we find that the action on m arising from that segment of the sphere will vary directly as the density; since to alter the density is the same thing as to increase or

* A *less* attraction or repulsion from a segment of *greater* density has not been considered, since it is at once inconsistent with hypothesis (3).

decrease in a fixed ratio the number of molecules acting from each element of volume of the segment. The same reasoning applies to the action from the second side of the plane on any other molecule on the first side which is sufficiently close; and as the number of molecules thus acted on will also increase directly as the density, and as the interpolated molecules will, from hypothesis (5), be acted on to the same amount, and in the same direction, as the original molecules between which they lie, it follows *that the pressure per square inch within the medium will vary as the square of the density.**

IV°. This pressure will of course be transmitted to the walls of the containing vessel, so that it becomes necessary to consider the conditions which must hold at the boundary of the medium. For this purpose three cases must be distinguished. The first arises along the surface of contact of two media, which obey, in the forces which they exert on one another, conditions consistent with our hypotheses. In this case, if the density of either medium vary after a state of equilibrium has been established, that of the other must vary in like proportion, otherwise the medium of increased density will force back the other. Again, if the range or law of the *mutual* molecular action of the two media differ from what hold with respect to the action of the molecules of either medium among themselves, it is evident that the density of this medium cannot be uniform, but must be different from its average value in the vicinity of the other medium. This alteration in the density of the superficial stratum will react on the stratum behind, and so on, producing a strained condition of the density throughout the medium,† which would even in some cases go the length of occasioning the precipitation of that medium upon the surface of the other. Another case, which is quite distinct, will arise when the medium is confined by a containing vessel, the walls of which are both rigid and immovable, but which acts on the medium within, not merely from its superficial layer of molecules, but from all those lying within a certain distance of the surface in such a way that no one molecule of the containing vessel contributes more than an infinitesimal part to the effect on a molecule of the medium. Up to a certain density and pressure the medium will be contained by such a vessel; but as soon as the density is made to exceed this limit, the medium will begin freely to permeate the vessel, and escape. The remarks made with reference to the last case apply equally to the present one, so long as the medium continues of sufficiently low density to be restrained. The third case of limiting conditions arises where the medium is kept in by the wall of a containing vessel which it can neither press

* In the particular hypothesis of modified action introduced by Professor Jellett there will be another term containing the fourth power of the density.

† Somewhat like the strains which are found to exist in substances which need careful annealing. Thus, it is well known that if a chip be broken from a sharply defining object-speculum or lens of a telescope, the strains which held the fragment in its place being annihilated, the distribution of the density and strains throughout the whole of the rest of the mass are so altered that the accuracy of the defining power is lost.

back nor penetrate. That this may be so, the outward motion of the *superficial* layer of molecules of the medium must meet with an absolute obstruction from the repulsion of the inner layer of molecules of the containing vessel. The forces thus coming into play would be at variance with hypothesis (4); on which account it is needless here to trace further the consequences of their action, several of which are, besides, sufficiently obvious.

This kind of examination might, indeed, be continued almost indefinitely, and extended to the crystalline texture of the medium and other branches of the subject; but enough has been done for my present end, which is to draw attention to the fact, that *no known ponderable material* possesses a constitution of the kind which has been supposed, and, consequently, that we are forced to admit, as demonstrated, the following points with reference to this obscure branch of Physics:—

1°. That no known ponderable matter consists of a continuous substance similar in all its parts.

2°. That by continuing the subdivision of *solids*, as far as is consistent with the parts being similar, similarly placed, and acting alike, either the whole, or at least a controlling part, of the action on each such molecule must be contributed by a finite number of those in its vicinity. The validity of this conclusion is not disturbed by attributing to the elementary molecules such motions as may constitute sound, heat, light, and electricity, and the statement is evidently *à fortiori* true of the parts of the elementary molecules.

3°. If liquids are separable into elementary molecules of the kind described in the last paragraph, similar to one another, similarly placed and acting alike, then the statement of that paragraph may be repeated, word for word, with reference to them; but if, as seems perhaps more likely, there is going on between the elementary molecules of liquids a constant interchange of their parts, then the language must be somewhat modified, although the conclusion remains substantially the same.

The case of gases is somewhat different. The examination which has been made above shows, no doubt, in the case of gases, as it does for either solids or liquids, that their constitution cannot be that of a *stationary* system, each molecule of which acts, but to a trifling extent, on each of those around it. But it does not show that it may not be such a system in a state of vivid molecular motion. The closer investigation of this hypothesis opens a new branch of the subject. Already, however, a positive step appears to have been made by *demonstrating* that in solids and liquids each molecule is acted on to a finite extent by those in its immediate neighbourhood.

Sir William R. Hamilton read a paper, "On some Transformations of Diverging Lines."

A collection of twenty-five ancient articles, consisting of bronze pins of several forms, the axis of a spinning bobbin, and two needles, all found near Gweedore, county of Donegal, were presented.

MONDAY, APRIL 26, 1858.

James Henthorn Todd, D. D., President, in the Chair.

J. Beete Jukes, Esq., read a paper "On the Lower Palæozoic Rocks of the South-East of Ireland and their associated Igneous Rocks."

Rev. Professor Haughton read a paper on the same subject, and described certain minerals as abounding in these rocks, which had been hitherto unnoticed in common granites of Ireland.

The Secretary read a letter from the Chairman of the Local Committee at Baltimore, inviting the Members of the Academy to attend a Meeting of the American Association for the Advancement of Science, to be held in that city.

George V. Du Noyer, Esq., presented a series of drawings of antiquities, made by himself, from bronze and iron antiquities in the Museum at Rouen, in September last.

Fleetwood Churchill, M. D., on the part of Dr. Lockhart, presented five porcelain seals, collected by that gentleman during his residence in China. Two of them have inscriptions exactly the same as the seals Nos. 2 and 51 engraved in the late Mr. Getty's work on Chinese Seals found in Ireland.

The Secretary announced the presentation of a medal by the Royal Norwegian University of Christiania, struck in honour of Dr. Christopher Hausteen having completed a term of fifty years as Professor of Astronomy in that University.

MONDAY, MAY 10, 1858.

James Henthorn Todd, D. D., President, in the Chair.

Rev. Charles Graves, D. D., read a paper "On a System of Imaginaries analogous to those employed by Sir William R. Hamilton in his Calculus of Quaternions."

The President read the following paper—

ON THE CONTENTS OF CERTAIN ANCIENT TOMBS IN THE NEIGHBOURHOOD OF ANET, IN SWITZERLAND.

I mentioned to the Academy on a former occasion that I had received a letter from M. le Baron de Bonstetten, of Berne, making some inquiries respecting the earthenware pipes, several specimens of which are preserved in our Museum. My answer to him was, that I could not regard these pipes as more ancient than the sixteenth century, and, consequently, that the idea of supposing them in any way connected with the Celtic race was wholly untenable.

The Baron has since been kind enough to send me an account of the opening of some ancient tombs at Anet, near Berne, in Switzerland, which is of considerable interest, as tending to establish some fundamental principles of archæological investigation.

First, however, let me say that the Baron has fallen into the very common error of supposing that the small wedge-like hatchets, commonly called *Celts*, are peculiar to the Keltic race. The name *Celt* ordinarily given to them has propagated this error; but that word is only the Latin *Celtes*, or *Celtis* (from *cœlare*, to carve or engrave), which occurs in the Latin Vulgate, Job, xix. 24:—"Quis mihi det ut [sermones mei] exarentur in libro stylo ferreo, et plumbi lamina vel *Celte* sculpantur in silice?"* But the name of the Keltic family of nations, in its correct orthography, is wholly different, Ꞡaoıꝺhel, Γαλαται, Gadelii.

Thus M. de Bonstetten records it as a fact which he appears to think inconsistent with his own very just conclusion of the non-Celtic origin of the tombs, of which I shall speak presently, that M. Müller, of Nidau, in the year 1848, opened a tomb on the hill of *Jolimont*, near Anet, in which were found a small bronze figure, "dont la costume bizarre n'a rien de romain;" a stone hammer, "et une de ces haches, ou coins en bronze communement appelés haches celtiques." If continental antiquaries call these implements "haches celtiques," it is evident that they have fallen into the error of imagining that the name Celt (i. e. *Celtes*, a chisel) is connected with the Celtic, or more properly Keltic, family of the human race.

The opinion of M. de Bonstetten, in which I entirely concur, is, that the tombs opened by him in the neighbourhood of Anet are to be assigned to a period subsequent to the introduction of Christianity into that country, that is, subsequent to the latter part of the sixth century; and I am inclined to believe them, for the reasons I shall give presently, very much later.

The real importance of the Baron de Bonstetten's discoveries, in reference to the science of Archæology, does not appear to have been fully perceived by himself. But I shall be better able to explain what I mean when I have given you a short account of the results of his investigations.

He found among the ruins of the ancient Chateau of Fœnis, about a league to the north of the village of Anet, near Berne, ten large tumuli, erected upon a wooded hill which overlooks Anet, and from which there is a view of the lakes of Morat, Neuchatel, Bienne, and of the chain of mountains from the Titlis to Mont Blanc. Six of these mounds were ranged at some feet from each other, on the crest of the hill, in a line running from east to west. The remaining four formed a semicircle at the end of this line. The mounds varied in dimensions from 6 to 15 feet in height, and 40 to 60 paces in circumference.

The first circumstance noticed by the Baron, which distinguishes these tombs from the Celtic and British sepulchral monuments of the

* It is curious that some MSS. and printed editions of the Vulgate (as that of Rob. Stephanus, Paris. 1528) have "vel certe sculpantur," a reading which is, no doubt, the true one, as being in accordance with the LXX. and with the Hebrew.

same kind is, that the stones forming the chamber of the tomb appeared to have been cemented together with mortar.

Another circumstance is, that some of these tombs contained two or three bodies, not laid together in the same chamber, as in our Celtic tombs, but in a lower, middle, and upper chamber, separated from each other by layers of stones or flags, the roof of the lowest chamber forming the bottom of the second, and so on. M. de Bonstetten remarks that he did not find in any case more than three such chambers, and that in the upper chamber were usually found, in addition to the remains of the third corpse, the ashes of burnt bones, on a bed of fine sand. The whole structure was surrounded and covered with small stones, giving the monument the form of a conical mound, resembling our cairns.

It is probable, from this account, that two different customs of sepulture may have coexisted at the time when these tumuli were constructed, —that of cremation, and that of burial, properly so called,—and that the burnt remains were in general placed at the top. Could it be that the Christians, in reverence for the hope of the Resurrection, were buried without cremation, and that the heathen serfs, or *pagani*, were burnt?

In confirmation of this opinion, it is to be observed that there were found in the same tomb articles which had evidently been subjected to the action of fire, and other articles which, from their very nature, could not have been in fire. Thus, in the first tomb, M. de Bonstetten found "bracelets de bronze, presque consumées par le feu," and also a wooden ring, a large ring of amber, and rings of bronze connected together by linen or worsted threads, the remains of which were visible, forming a sort of light coat of mail, intended evidently for ornament rather than for defence. In other tombs he found the remains of chariots in wood, a buckler, with the remains of the leather of which it was composed, rings of wood and of amber, leather harness, and other things which evidently could never have been subjected to the action of fire.

But it will be better to describe very briefly what was actually found in these tombs before we make any general remarks on their contents.

Tomb I.—After digging seven feet, large flags were found, covered with a black paste-like substance (probably decayed animal matter), mixed with fragments of bones, whether human or animal M. de Bonstetten does not inform us. At the northern side were found fragments of rings or bracelets of hollow bronze, which, as already remarked, were almost wholly consumed by fire, a wooden ring, and a large ring of amber, resting on a layer of gray dust; also, as above mentioned, the remains of a garment of linen or coarse stuff, ornamented with small rings of bronze, similar to those used in coats of chain-armour. At the east end of the tomb were found the remains of an armlet of hard wood, covered with a black varnish, and the remains of a bronze plate, which appeared to have been originally fastened upon leather, and seemed to have formed part of the breast-plate of a coat of armour. It was delicately engraved, in zig-zag lines, forming elliptic and semi-elliptic ornaments, and it had still two rings, intended apparently for fixing it upon the shoulder. Some fragments of pottery were also observed.

It would seem, therefore, that this was a tomb the occupant of which had been interred by cremation, the burnt remains having been deposited in urns of pottery along with the unburnt armour of the deceased; and these deposits having been covered with flags, the remains of some other bodies, which seem to have been also burned, were spread on the top. The existence of wood and leather seems incompatible with a very high antiquity.

Tomb II.—At a depth of four feet were found two rings of bronze, covered with a fine rust, and, one foot lower, a fibula; one foot lower still, or six feet from the surface, an iron hook, apparently the remains of a spur; and a small ring of iron; together with fragments of pottery and large iron circles, with nails and wood inside, which M. de Bonstetten supposes to have been the remains of the wheels of a chariot.

Tomb III.—This tomb was only six feet in length and forty paces in circumference. At a depth of two and a half feet were found two bronze armlets, two bracelets, a bronze band or collar for the neck, which M. de Bonstetten supposes to have been a female ornament, and other fragments of bronze, engraved in relief or stamped.

The collar was a thin plate or flexible lamina of bronze, with the hooks or fastenings still remaining which held it at the back when placed round the neck. It is ornamented in the same style of zig-zag which has already been noticed on the breast-plate found in Tomb I., the zig-zag lines being disposed in semicircles, right lines, and triangles.

The armlets are of a kind not found, so far as I know, in any Celtic monuments: they are hollow cylinders of bronze, intended apparently to cover the arm from the wrist to within an inch or two of the elbow-joint, and the bronze appears to have been fastened to an internal cylinder of wood, at least in the case of one of them, of which one-half was perfect, and which contained a small bracelet (I presume in bronze, although M. de Bonstetten does not say so), and the remains of a wooden handle, which M. de Bonstetten supposes to have been part of a distaff.

On reaching the level of the ground, M. de Bonstetten perceived that in the centre of the tumulus the earth had been moved, and on digging down he found the flags of a second tomb, on which lay the umbo of a shield. It was ornamented with concentric circles of bronze, engraved in chevrons, and fastened round the umbo by thongs of leather, passing through the triangular ornaments of the bronze circles, and sewing them to the body of the shield, which seems to have been also of leather, from the fatty and black paste-like substance with which the flags were covered. There were also found, along with the remains of the shield, a small buckle, a bracelet (of bronze, I suppose), a thick armlet of wood, not varnished, as some of the other wooden articles were, and a ring of amber.

Tomb IV. contained only some remains of bones, and a piece of oxidized iron.

Tomb V.—At two feet from the summit was found a layer of sand and burnt bones; two feet lower, in another layer of sand, towards the N. W. side of the tumulus, were fragments of coarse pottery, mixed

with pieces of charcoal and bones, the remains of a bracelet of wood, covered with thin bronze, three smaller bracelets in bronze, a clasp (bronze) of delicate workmanship, large fragments of narrow bands of bronze, ornamented in relief, intended as ornaments of the head, or, perhaps, stitched upon a garment, and three buttons much corroded, which were found buried in a gray dust, the remains, as M. de Bonstetten conjectured, of some kind of stuff or cloth garment.

Under the second layer of sand were found the stones of a third sepulchre, which contained bronze armlets, much broken, a bracelet of elastic wire, and a ring of bronze; also a large ring of amber, too large for the finger, but too small to have been worn on the arm or wrist, and a great number of small, thin plates of bronze, resembling the scales of a fish, lying together in a brown substance, which damp had reduced to a sort of paste, and which was probably the remains of cloth, on which they had been stitched, to form a light coat of mail.

Tomb VI.—This tumulus was higher than any of the rest. It contained, at two feet from the top, a broken urn (clay), full of ashes; a foot lower was a bed of cement, formed of stones and sand, which increased in thickness towards the centre of the tomb. In it were found, placed so that the lines joining their centres would have formed a rectangle, four circles of iron, twenty-three inches diameter, with nails which had evidently fastened them to wood. One of these was broken, but the other three were entire. Near each of these iron circles was an iron round plate, one inch broad, and four in diameter, which had been fastened upon wood with nails, and had a rim or flange on its outer circumference of about three inches. From these remains—the position of the four iron circles, and the fragments of wood still adhering to them, the number of nails, fragments of rings and of iron plates found surrounding them—M. de Bonstetten concluded that this tumulus had contained a chariot, with four wheels, which had been buried with the corpse or ashes of its owner. Between the wheels of this chariot he found also a human thigh-bone, and an iron sword, fifteen inches long, in a sheath of bronze.

Having dug through the thick crust of cement which formed the floor of the first chamber, he came upon an immense mass of stones, of all shapes and sizes, piled upon each other. At a depth of twelve feet from the top of the tumulus were found large flags, on which were a prodigious quantity of remains of leather, wood, iron, and bronze, and circles of iron, or wheels, similar to those found in the upper chamber. Here M. de Bonstetten found large fragments of leather harness, ornamented with copper nails arranged in squares and triangles; a piece of wood, ornamented in the same way; several rosettes or buttons of bronze fixed to thongs of leather; an iron horse-bit; a horse's breastplate in bronze; and a plate of bronze in the form of a crescent. Further on were found large remains of an ornamental grating or trellis-work in bronze, which had evidently been fastened upon wood with nails, and was strengthened round the edge with bars of iron; more than twenty cones of wood, which was found to be hazle, covered with thin bronze, were also discovered; these M. de Bonstetten supposes to have been the spokes of

the wheels, and the bronze trellis-work to have been the ornaments of the body of a chariot.

Fragments of a human skull, with the jaw-bone, were also found, together with two sword handles; a chain of gold in filigree work; a bead or runner of solid gold, about half an inch in diameter, the surface of which was highly ornamented in relief.

All these objects were found under large stones placed upon the flags at regular intervals, leading to the conclusion that the chariot had been taken to pieces, and its several parts, with the other articles, laid out upon the flags.

In this tumulus was also found a piece of flint, cut like the flint of a gun-lock, which M. de Bonstetten supposes to have been an amulet; also a triangular, irregular, fragment of stone, three feet wide by two high, which was found built into the side walls of the chamber, and seemed like a fragment of some larger stone, the surface of which had evidently been cut by human art. The position of this fragment in the wall was purely accidental; two lines crossing at right angles traversed the surface of the stone, and within the angles thus formed were several circular holes of different sizes, and of about half an inch deep. M. de Bonstetten seems disposed to believe that this stone had some connexion with the ancient paganism of the country, and that its having been broken and used as the material for ordinary building is an evidence that at the period when this tumulus was erected, Christianity had already undermined the ancient superstitions.

Tomb VII. contained nothing but an iron ring or bracelet. It had an enclosure of stones on the south side only, and was much smaller than the preceding.

Tomb VIII.—After penetrating a covering of mortar mixed with clay, at a depth of five feet lower, there was found a large vessel of thin bronze, without ornament, three feet high. The diameter of the mouth was three feet, that of the base one foot four inches. It stood in a second bottom of wood, with a large rim outside, much decayed. The earth in which this vessel was embedded was so hard, and adhered to it so strongly, that the vessel was much broken in the attempt to get it out; it was filled with gray dust and fragments of cloth, which adhered to its sides. Near the vessel was found a small plain gold ring, apparently part of an ear-ring; also a collar or neck-lace formed of hollow balls of thin gold, which had been on a string; each ball something more than an inch in diameter, but all of them much battered and bruised; also the remains of a crown or diadem of thin gold, with some fragments of a human skull. This diadem was ornamented by a stamp impressed on the inside, rendering the ornament concave inside, and raised in relief outside; the ornament consisted of concentric circles, composed alternately of small squares, circles, and triangles, with lines between. M. de Bonstetten supposes the form of this diadem to be that of a cap or bonnet, resembling the crowns to be seen on the statues of the Merovingien kings on the portico of the church of St. Denis. The outer edge was turned back on itself, forming a border of about half an inch,

ornamented with fine crossing lines. Remains of a thin plate of bronze were found adhering to the inside in several places, evidently an internal lining for strength. Near this was discovered a brooch of hollow bronze, and two large rings, arm-rings apparently, of wood. Two chariot wheels, of which the iron shoeing only remained, were placed upright on each side of the bronze vessel already described; large fragments of the timber of which they were composed were found all around. At a foot lower were found the flags forming the roof of a lower sepulchral chamber. In this were a wooden armlet, a buckle, a bronze bracelet, of somewhat elaborate construction, and fastened with a hook and eye; the umbo of a shield, fastened by thongs of leather to circles of bronze, exactly the same as the umbo found in Tomb III. The leather crumbled into dust on exposure to the air.

Tomb IX.—On the top of this tumulus was a circular sunken space, about a foot deep, and seven in diameter. The interior of the tumulus consisted of a circular wall of stones, about from three to four feet high; the centre was filled with earth and lime, forming a cement so hard that it was broken with great difficulty. The Baron found here only charcoal, and two pieces of iron, which seemed the remains of a hook.

From this circumstance he concludes that a tumulus of this construction was intended only for the reception of the bodies of serfs, or the lower orders; whilst the tombs of kings or nobles were constructed altogether of stones and flags, the quantity of stones piled up upon the cairn being proportional to the rank of the deceased.

Tomb X.—A large beech tree grew on the top of this mound, which rendered it necessary to open it at the side. After removing a large upright triangular stone of flint, large horizontal flags were discovered, on which lay two great armlets, of the same kind as those formerly described, both of wood, but broken and decayed; two bronze rings or bracelets for the wrist, and one, also in bronze, of the spiral form, being a bronze wire twisted several times in a spiral round the arm; a fragment of a bronze plate, with engraved ornamentation, a wooden ring, and a plate of bronze, bearing in relief a Greek cross. The existence of this ornament, worn probably on the breast or round the neck, seems to prove that this, and the other tombs of similar contents and construction, are to be assigned to the Christian period.

It remains now to make some general remarks on these ancient sepulchres.

There can be very little doubt that the steel sword, with its bronze scabbard; the gold chain of filigree work, and the gold bead, which seems to have belonged to it, were of Roman manufacture. Many similar articles are to be found in the museums of Italy. The chariot of four wheels, ornamented with bronze trellis-work, is also most probably Roman, and M. de Bonstetten shows that it was a Roman custom to bury or burn shields, armour, chariots and harness, with the bodies of the illustrious dead: so Virgil—

> "Hinc alii spolia occisis derepta Latinis
> Conjiciunt igni, galeas, ensesque decoros,
> Frenaque, ferventesque rotas."—*Æn.*, lib. xi.

On the other hand, the "brassards," as M. de Bonstetten terms them, i. e. armlets, or arm protectors, of wood and bronze, the bronze collar, the diadem of gold, the necklace of hollow golden balls, and the rings of amber, are evidently not Roman: nor do these tombs seem to have contained anything decidedly and unquestionably Celtic.

The Baron de Bonstetten is, therefore, I think, fully justified in the conclusion that these tumuli are not of a high antiquity: the Greek cross found in Tomb X. shows them to have been subsequent to Christianity; their contents indicate a period of transition from the old civilization of the Roman Empire, to the rude and more barbarous manners of the feudal ages. He infers then that the Helveto or Gallo-Romans, are the only people to whom we can attribute the tumuli of Anet.

But a still more important conclusion he has omitted to draw from an examination of the contents of these sepulchres. It is evident that they at once refute the attractive theory of the Danish and some German antiquaries, of a Stone, a Bronze, and an Iron period. In these tombs we find wood, iron, and bronze together. We find even protective armour for the body, of all these materials: and M. de Bonstetten mentions in one instance a flint, which he supposes to have been an amulet, but which was more probably one of those flint, spear, or arrow-heads so commonly found in Ireland. It is evident, therefore, that there is great danger of our being led to distort or falsify historical facts, if we suppose the existence of a chronological period defined by the use of stone, another by the use of bronze, and a third by the use of iron. On this subject, however, I would refer you to the able remarks made in this room by the late lamented John Mitchell Kemble, little more than a year ago, which have been printed in our Proceedings, and which I caused also to be printed in a separate form. In that able paper, the last production, alas! of its accomplished author, you will find also some valuable remarks on the subject of ornamentation as a characteristic of race. The ornamentation of the articles found in the tumuli of Anet is all evidently of the same character, and strongly confirms the conclusion arrived at by M. de Bonstetten of their belonging to the Helveto or Gallo-Roman race. But I have already occupied so much time, that I must forbear making any further remarks on this subject, and I shall, therefore, content myself with observing only that the Greek or Pelasgic people of Italy have left behind them bronze articles, with the same ornaments of alternate rows, composed of serrated lines, of circles, of lozenges, and of triangles, which form almost the exclusive style of ornament on the bronze remains found in the tombs of Anet, and that the same combination of the serrated zig-zag with the circle, triangle, and other geometrical figures, seems to have been characteristic of the Teutonic or Germanic tribes.

It is to be regretted that M. de Bonstetten has not more minutely described the pottery found by him in these tombs. He mentions it only in general terms; and does not say whether it exhibited any or what kind of ornamentation; nor does he tell us whether the fragments disinterred by him were the ruins of sepulchral urns, or articles for culinary

or domestic use. It is most probable, therefore, that they were of the latter class, for it is scarcely to be supposed that if they had been of the nature of our clay sepulchral urns, of which so many specimens are preserved in your Museum, so accomplished an antiquary would have passed them over without notice.

The following heel-ball rubbings, made by Captain W. Persse Newenham, R. N., were presented by that gentleman to the Academy:—

Nos. 1, 2, 3, and 4, from brasses in St. Mary's Redcliff Church, Bristol.

Nos. 5 and 6, from brasses in the Temple Church, Bristol.

No. 7, from a brass in Swainswick Church, Bath.

No. 8, from a brass in the Abbey Church, Bath.

Nos. 9 and 10, from Turkish tombs brought from the Crimea.

Nos. 11 and 12, from sculptured stones found in a by-street in Alexandria.

MONDAY, MAY 24, 1858.

James Henthorn Todd, D. D., President, in the Chair.

On the recommendation of the Council, it was—

Resolved, That the sum of £50 be placed at the disposal of the Committee of Antiquities, for the purpose of purchasing articles for the Museum.

His Excellency the Lord Lieutenant having arrived,—

The President delivered the following Address:—

My Lords and Gentlemen,—The Council have imposed upon me the grateful task of announcing to you their recent award of the Cunningham Medals, and of explaining to you the grounds upon which they have adjudged them to the four gentlemen to whom I am commissioned to deliver them at this meeting; but I must, in the first instance, return thanks to his Excellency the Lord Lieutenant, who has most kindly consented to give additional honour to the distinction conferred upon those gentlemen by his presence on this occasion.

Before I proceed to the principal subject to which I have alluded, perhaps you will allow me, for his Excellency's information, as well as for yours, to give a short account of the history of the Cunningham Medals, and the different plans that have been, at different times, adopted of awarding them.

Timothy Cunningham, of Gray's Inn, London, left to the Academy, by his will, the sum of £1000. This bequest was notified to the Council August 1, 1789, and to the Academy, October 31, 1789; and in these facts, I am sorry to say, is contained almost all I know of our benefactor. The Academy made every effort to obtain a bust or a picture of him, but no such memorial was in existence.

His will left full powers to the Academy to dispose of his bequest according to such rules as the Council might, from time to time, enact, for the encouragement of learning in Ireland, by offering Prizes for Essays on certain subjects, or giving rewards to distinguished authors; and accordingly, different plans have, at different times, been adopted.

The first plan was that of giving Prizes for the best Essay on a subject proposed by the Academy.

This was soon afterwards altered, and "The Cunningham Gold Medal" was instituted instead of a pecuniary prize.

These Medals were for some time given for papers published in the Transactions of the Academy, but this plan was objected to as narrowing too much the field of competition, and diminishing in proportion the honour of the reward.

Accordingly, in the year 1848, the plan now in operation was instituted. It is as follows:—

1. All works or Essays, in the departments of Science, Polite Literature, or Antiquities, which shall be published in Ireland, whether in the "Transactions of the Academy" or not, or which shall relate to Irish subjects, may be considered as competing for the Medal.

2. The Council shall award Medals every third year, and shall then take into consideration all papers or works coming under this description, which have been published within the six years preceding.

3. Money premiums shall, from time to time, be given for Essays or Reports on stated subjects.

This last regulation has never as yet been acted upon, the fund at the disposal of the Council having been found too small to enable them to carry out both objects; this is the more to be regretted, as it is evident that the Medals given in accordance with the first and second rules do not produce or encourage new researches, but only reward those authors who had laboured independently, and whose works would have been published, whether any such Medals had been given or not.

But besides this, our Medals are, in my opinion, open to a still greater objection, owing to the fact that they are of gold, and that they are all struck from the same die. A gold medal is necessarily unique: it is locked up in a strong box during the lifetime of its owner, and at his death it is, in many cases, disposed of for the value of the gold, by his executors or his heir. A gold medal, therefore, does not spread the fame, either of the individual who receives it, or of the Academy by whom it is given. But the Gold Medal of the Academy is objectionable on another ground: in that it contains nothing to indicate either the person to whom it was awarded, or the reason why it was given to him. The Medals are all from the same die, whether they are given for the advancement of science, or for classical learning, or for the promotion of archæological knowledge,—and if one of them were stolen or lost, there is nothing to indicate to whom it once belonged.

I am, therefore, very much disposed to prefer the plan suggested many years ago, I believe in 1839, by Dr. Aquilla Smith. The main features of this plan are, that the Medal should be of copper, bearing on

one side a permanent device, and on the other a portrait of the individual to whom it is given, with an inscription containing his name, and the reason why the medal was awarded. A certain number of copies of each Medal should be sent by the Academy to royal and public cabinets at home and abroad, and the remainder sold to Members and to the public. A single copy in silver to be given to the person who receives the medal, but no gold impression to be taken.

The advantages of this system are, that it spreads at once the fame both of the Academy and of the individuals distinguished by the Medals. Collectors will look eagerly for them; a series of them will be preserved in every public cabinet, and in all the principal private collections; and the money now spent uselessly in the purchase of gold will be expended in the encouragement of art, inasmuch as every Medal given must have a new and peculiar die sunk for it.

To return, however, from this digression to the proper business of this meeting.

The Medals now about to be given ought, strictly speaking, to have been given last year; but the death of our Treasurer, the late Dr. Ball, and some private matters connected with our finances, induced the Council to postpone the delivery of them until now; and I am glad that these accidents are attended with at least one good result, that we are now honoured by the presence of the distinguished nobleman who so worthily represents her most sacred Majesty in this country.

In consequence of the interval that has elapsed since the last distribution of these Prizes, the Council have resolved to give four on the present occasion, two in the department of Science, one in that of Polite Literature, and one in Antiquities.

On the recommendation of the Committee of Science, the Medals have been awarded to Edward J. Cooper, Esq., M. P., of Markree Castle, for his "Catalogue of Ecliptic Stars;" and to the Rev. George Salmon, for his researches on the "Geometry of Plane Curves."

On the recommendation of the Committee of Polite Literature, a Medal is adjudged to the Rev. Dr. Wall, for his important work on the "Ancient Orthography of the Jews, and the Present State of the Text of the Hebrew Bible."

On the recommendation of the Committee of Antiquities, the Rev. Dr. Reeves is to receive a Medal for his new edition of Adamnan's "Life of St. Columba."

It will be necessary for me to give you some little account of the works to which we have thus awarded our highest mark of approbation.

I. Much importance has of late years been attached by astronomers to the formation of catalogues and charts of stars in the vicinity of the ecliptic, the region of the planetary movements. The fixed points, whose positions are thus determined and mapped, not only serve as points of reference for the places of the moving bodies of our system, but they afford also most important facilities for the discovery of new planets. They enable us to determine the variation in the position of a moving body, by a simple micrometrical measurement, or even by ocular

triangulation, and so render much more easy the detection of those regular variations of place which enable us to pronounce the moving body to be a planet.

Induced by these considerations, and stimulated by zeal for the advancement of his favourite science, our fellow-Academician, Mr. Cooper, undertook the laborious and formidable task of determining the position of all the stars in the neighbourhood of the ecliptic, to the twelfth magnitude inclusive. His Catalogue contains no fewer than 60,066 stars, of which by far the greater part have been determined for the first time. This gigantic undertaking was commenced in 1848, and has occupied nearly eight years. In that time upwards of 72,000 observations were made, including the two co-ordinates of right ascension and declination of the observed body; in other words, 9000 observations yearly. The Catalogue has been published by the aid of the Parliamentary grant of the Royal Society, and extends to four volumes; but Mr. Cooper has announced his intention of publishing a fifth, or supplementary volume, to complete the work.

I must, however, call your attention to a singularly interesting and remarkable circumstance, which was discovered during the progress of this undertaking. A large number of stars (as many, I believe, as seventy-seven) which had been previously observed, and their positions noted, were found to have disappeared. Of these, fifty had been catalogued by Mr. Cooper in the earlier years of the progress of his work, but, when sought for of late, are found wanting. The remainder are stars that were noted in the catalogues of foreign astronomers.

This remarkable fact of the disappearance of stars recently observed, has been fully confirmed by the labours of M. Chacornac, who has been engaged, simultaneously with Mr. Cooper, in forming a catalogue of ecliptic stars, and who has already published eighteen charts of their positions.

It is, of course, quite possible that some cases of supposed disappearance may be apparent only, arising from the errors of former observers, and some, perhaps, also by the discovery of small planets, belonging to the group between Mars and Jupiter, whose nature was not recognised at the time of observation, and which were mistaken for stars. But it is quite certain that by far the greater number are real disappearances, and can only be accounted for by an actual variability in the stellar systems, whether periodical or otherwise. The number of known *variable* stars—stars whose brightness varies periodically,—has been greatly augmented since the attention of astronomers has been directed to stars of inferior magnitude; and it is not improbable that the stars which have disappeared belong to this class, and that they will consequently be found to *reappear* at some future time. But we cannot without great presumption conclude that all are of this class, and that all the stars now seemingly extinguished will reappear at distant intervals;—in other words, we cannot presume to assert that there are no permanent changes in the stellar system not compensated by opposite fluctuations; and if this be so, the observations published by Mr. Cooper, and others of a

similar kind made by other astronomers, acquire an importance far beyond that belonging to their immediate object; opening up, in fact, a new field of astronomical inquiry, and new motives to diligence and accuracy in the arduous labour of mapping the stars.

I have said nothing of the manner in which Mr. Cooper's work has been performed, or of the excellence of the observations themselves. This is a point upon which none but practical astronomers can form a judgment. But we have the strongest external evidence, in the way of presumptive proof, that the observations are of the highest value for their accuracy and excellence; not only from the known scientific zeal and devotion of the accomplished director and proprietor of the Markree Observatory, the perfection of the costly instruments which his enlightened liberality has provided, but also from the high astronomical character and ability of Mr. Graham, his first assistant, under whose superintendence the observations were made. I may add also, that the instrument employed was the great Markree Equatorial, the eye-piece of which was furnished with a micrometer of a peculiar construction, devised by Mr. Graham; and that the same magnifying power was used throughout the whole series of observations.

II. The chief merit of Mr. Salmon's "Treatise on the Higher Plane Curves" is the clear and full exposition of all modern improvements in the methods of analytical research which it contains. The author does not profess to have made any new discoveries, or to suggest new methods of investigation, but he has done both; and this new matter is introduced with so little parade, or, I should rather say, generally without any notice at all, that it requires considerable knowledge of the subject to distinguish the discoveries of Aronhold, or Plücker, of Poncelet, or Joachimsthal, from the new and highly interesting propositions introduced whilst giving an account of the investigations of those authors, and connected with their researches, but due altogether to Mr. Salmon.

The method of investigating the properties of conic sections by reference to two tangents and the line joining their points of contact, and the analogous method applied to cubics of the third class; the application of the theory of determinants to the discovery of the properties of curves, particularly to finding the reciprocals of curves of the third and fourth degrees; the investigation of the focal properties of cubical biquadratic curves, and many other new properties of conics,—may be mentioned as original, the result of Mr. Salmon's genius and research. But, however valuable and interesting these additions to what previous writers had discovered, the great practical value of the work is, that it arranges in a clear and connected system all the important geometrical discoveries hitherto published, so that, to use the author's own words, "each new student, who wishes to devote himself to original investigation in any branch of mathematics, may have his energies brought to bear upon the undiscovered part of the science." Such a student, with the aid of Mr. Salmon's book, without the labour of searching the scattered papers in scientific journals, or transactions of societies, will at once see what has been already done, and will escape the danger of wasting his abilities by rediscovering what others had discovered long before.

It would be premature to speak of Mr. Salmon's investigations in the geometry of three dimensions, as they have not as yet been fully given to the public; but we have already had a foretaste of what may be expected from him in this higher region of mathematical research, as he has already read to the Academy a valuable paper on the "Reciprocal of a Surface of the Second Degree," and he has contributed to different periodical journals most important investigations relative to the surface of the third degree: all of which, with many additions, we may look forward to in a collected form, in a third volume of his Geometry, devoted to the properties of surfaces.

III. It is now more than 200 years since Louis Cappel, who died in 1658, published his celebrated "Arcanum Punctationis Revelatum," in which he maintained that the Hebrew vowel-points and accents were no part of the inspired text of the Old Testament, but were to be regarded in the light of an uninspired commentary, added to the text at different times, and brought by degrees to perfection by the Masoretic doctors. Cappel was a Protestant minister, and Professor of Hebrew at Saumur, in France; and such was the opposition made to his opinions by his brethren, that he was forced to send his work to Holland, where the first edition appeared without his name, under the editorial care of the celebrated Erpenius. He was represented as in league with the Jesuits to undermine the authority of the Bible; his congregation repudiated him; he was deprived of his Professorship; and the magistrates of the town were called on to banish him from his home, as if he had been an offender against society.

It is well for Dr. Wall that he lives in better times. He has gone further than Louis Cappel ever dreamt of going; he has adopted all Louis Cappel's doctrines as to the modern origin of the vowel-points; and, instead of driving him from the University, or handing him over to the police, this learned Society meets together to-night, in presence of her Majesty's honoured representative, to confer upon him our highest literary distinction. Thus it is that learning and enlightened liberality ever go hand in hand. It was ignorance, rather than bigotry, that ignited the zeal of Cappel's persecutors. It is the advancement of learning that enables us now to do honour to the memory of Cappel, and to recognise in Dr. Wall one who has made a great further advance in the science of Biblical criticism. We see now that the question of the true inspiration of the Bible is not really affected by the discovery of Cappel, nor even by that of Dr. Wall,—that, on the contrary, the removal of an error must always clear the way to the discovery and elucidation of the truth.

It is not easy to give a clear idea of the nature of Dr. Wall's theory to those who are unacquainted with the Oriental languages; but I shall venture, trusting to your indulgence, to make the attempt.

He maintains that when men first attempted to record their thoughts by writing, hieroglyphic pictures were naturally the first mode of doing so that occurred to them.

He asserts that the great defects and necessary obscurity of this method of writing, being inadequate to the fulfilment of the Divine

purpose of giving to mankind a *written* revelation, not subject to the uncertainty of tradition, the Almighty was pleased to reveal to Moses the *principle* of alphabetic writing; and the Tables of the Law, written by the finger of God, were the first example of words expressed in writing by an alphabetic representation of their elementary sounds.

In this primitive revelation of alphabetic writing, it is to be borne in mind, that it was the *principle* only that was revealed. With that economy of miracle which characterizes God's dealings with man, the Almighty revealed to Moses, as Dr. Wall maintains, only this principle, —that, instead of pictorial objects to represent things, and arbitrary pictorial symbols to represent abstract ideas, the *sounds* of language might be analyzed into their elements, and writing made a representation, not of thoughts or objects, but of *sounds*.

According to this theory the alphabetic principle was not revealed in its perfection, but in its elementary idea; and men were left to work out that idea, and to perfect their alphabetic systems for themselves. I cannot stop to attempt any account of Dr. Wall's learned dissertations on the progress and defects of alphabets, and on the very curious subject of the ideagraphic system of writing still in use among the Chinese. I must hasten to the essential part of his theory, in its application to the Hebrew Bible.

He maintains that the Book of Job was first written in hieroglyphics, and was translated by Moses into alphabetic writing. He supports this opinion by most ingenious arguments, and shows that this hypothesis explains in a remarkable way the obscurity of style complained of in that sacred book.

He maintains that the letters of the Hebrew alphabet were originally the representatives of syllabic sounds, not of consonants or vowels; that the letter *b*, for instance, represented *ba*, *be*, *bi*, *bo*, *bu*, indifferently, according as the context required; there was nothing in the alphabetical character (ב) itself to determine which of these vowel sounds was to be connected with it.

Hence the ancient Orientals had no vowels among their alphabetic characters, and it was not until they became dead, or partially dead, languages, that the necessity of something more than a syllabic alphabet was felt. When the Jews returned from the Babylonish Captivity, where a new generation had been born, and had consequently forgotten, in a great degree, the language of their forefathers, a difficulty was found n th e reading of their sacred writings.

At this period, therefore, *began* that more ancient vocalization which Dr. Wall has discovered in the Masoretic text of the Hebrew Bible. Cappel made the far easier discovery, that the points and accents could not be an original part of the orthography of the language; they bear on the very face of them evidences of gradual and of modern growth. We have the very Jews themselves confessing the fact. We find the Talmudic doctors ignorant of them, and making no mention of them, in places where they must have been mentioned, if the system in its full perfection, as extant now, were known to those writers. But Dr. Wall main-

tains, and he has supported his theory by most ingenious arguments, that there exist in the Hebrew text traces of a vocalization much more ancient than the points, aiming at supplying the defects of a syllabic alphabet by the insertion of vowel-letters, not actually vowels—for they are used also as consonants—but of a class of letters peculiar to the Shemitic languages, which grammarians, by a sort of anticipation of Dr. Wall's theory, have called *matres lectionis*. This older vocalization he believes to have been completed about the second century of our era; and consequently, like the points, to be no more than an uninspired commentary, of great value indeed, but still an uninspired commentary on the text. He believes this commentary to contain many errors, and to be susceptible of improvement, and he has thus opened to Biblical critics a new field of investigation for the emendation and correction of the text.

I am afraid that I cannot venture to enter more in detail into the explanation of Dr. Wall's theory; but I cannot help referring you to his comparison of the present Biblical Hebrew with the ancient Phœnician inscriptions, chap. vi. of his last volume, which is certainly one of the most curious and ingenious arguments he has adduced in favour of his theory of the ancient use of the *matres lectionis*, as vowel-letters.

I would also notice his very ingenious explanation of the feminine forms in the verb, which he accounts for by supposing that the ancient Hebrew pronoun had no gender; *he*, *she*, and *it*, having been denoted by the same sound, so that it was necessary to denote the sex of the speaker or agent by giving gender to the verb. And he shows that this observation enables us to clear up many apparent inconsistencies in our present text, and to explain many anomalies and mistakes in the Masoretic vocalization.

IV. Dr. Reeves, for his valuable edition of Adamnan's "Life of St. Columba," has been awarded a Medal in the department of Antiquities.

To estimate the value of the original work, it is necessary to remark that its author, St. Adamnan, flourished in the middle of the seventh century, and that the MS. from which Dr. Reeves has printed was written by a scribe, who is, in all probability, to be identified with the Dorbene who was Abbot of Hy for five months only, and whose death is recorded by our Annals on October 28, 713: and as Adamnan died in 704, it is not impossible that this valuable MS. (now at Schaffhausen, and formerly belonging to the Irish Monastery of Reichenau), may have been written before the death of Adamnan, and, perhaps, under his inspection.

This MS. is professedly the text from which Colgan's edition of the life was printed; but there are so many arbitrary alterations, and such gross typographical errors in that edition—omissions frequently of whole sentences—that to Dr. Reeves belongs the honour of having, for the first time, given a correct and scholarlike edition of the text of this ancient and authentic work, retaining the curious orthography of the MS., which Colgan modernized; for in Colgan's time the importance of retaining these seeming inaccuracies of spelling was not understood; but we now know them, very much from Dr. Reeves's labours, to be of the

greatest interest as being characteristic of the Latin MSS. written by Irish scribes, several of which exist in Continental libraries, and which are only now beginning to attract the attention of philologers. Dr. Reeves has given in his Preface a valuable table of these peculiarities, classifying them under two heads—interchange of vowels, and interchange of consonants—and has compared them also with similar peculiarities of orthography in the "Book of Armagh."

In the copious notes with which this edition of Adamnan is enriched, Dr. Reeves has collected a vast body of historical and antiquarian information, throwing great light on the constitution, manners, and customs of the Scotic or Irish Churches of the seventh and eighth centuries. He has also identified, for the first time, the names of a great number of places mentioned by Adamnan, which had previously been unknown, and were indeed frequently misprinted, and, in some cases, altogether omitted by former editors. It will be seen at once what a very important evidence of the authenticity of the work may be derived from this circumstance; as it would have been impossible for any person not living at the period, and on the spot, to have introduced so large a number of true topographical names, the greater part of which are now identified with existing (although obscure) places in the Scottish islands, to say nothing of the names of individuals and families which also may be identified, and their dates fixed, by references to our native Irish genealogies and Annals.

In the Appendix of Additional Notes, which occupies nearly half the volume, Dr. Reeves has given a number of most valuable dissertations on subjects requiring a more full illustration. One of these may be briefly noticed, although it is by no means the most important in antiquarian and historical value; but its subject may be more easily explained, and it refutes a curious and wide-spread error, which it is now, perhaps, hopeless to correct,—I allude to the name of the island Iona, the seat of St. Columba's most celebrated monastery. I have seen etymologies of that word by Scottish antiquaries, making it out to be a compound of I-ċona, or "island of waves," and I remember exciting the wrath of an antiquarian friend in Scotland when I ventured, some years ago, to express my doubts of that etymology. It has also been, with at least equal absurdity, derived from the Hebrew *Iona*, a dove, and explained as an allusion to the name of its patron saint, Columba. The Gaelic etymology, *I-shona*, or "the happy island," has also been suggested; and all these puerilities are widely circulated down to the present day, in the tourist's guide-books, and in other works of higher pretensions: but Dr. Reeves has shown that there is in reality no such word as *Iona*, and that the island never was so called in any ancient or authentic document. The fact is that the *n* is a mistake for a *u*, a circumstance that was unknown even to Ussher, and which is now, for the first time, established beyond the possibility of a doubt by Dr. Reeves. The proper name of the island, as it is found in all the ancient sculptured monuments there still extant, and in all authentic records, is I, or Hy—and I- [or Hy-]Columkille, the I, or island, of Columcille—and Dr. Reeves has fur-

ther shown that Ioua is an adjective—the adjective formed from the proper name I, and that Adamnan has always used it in connexion with *insula*, "Ioua insula"—the island of I.

The change of *u* to *n* appears to have taken place in the fifteenth or beginning of the sixteenth century, and the error was favoured by the very slight distinction between the *u* and *n* in the black-letter writing of that period. The *n* occurs in the "Breviary of Aberdeen," printed in 1509–10; and it is found upon one tomb, and upon one only, in the island, which records the death of a Prioress of Hy, who died in 1549. It is remarkable that a similar error of *num* for *mun* occurs in the text of the *Te Deum*, which originated at the same period, the beginning of the sixteenth century; and it is curious that the present Churches of Rome and England agree in adopting the erroneous reading of *numerari* instead of *munerari*, so that the mistake has had a still wider circulation than that of Iona for Ioua.

I shall only just allude to another note which throws light upon the popular corruptions of ancient names, and gives some curious instances of the transformations of the name of Adamnan. By an aspiration of the *d* in this word the first syllable *Ad-* is pronounced, in many parts of Ireland and Scotland, like *Au, Eu, O, Ou,*—the *m* is also aspirated, and pronounced like *w*, or its sound altogether dropped. Hence in Sligo the saint is termed *Awnan* or *Aunan;* in Raphoe he is St. *Eunan;* in the county of Londonderry he is *Onan;* and we find the same form in the topographical name *Sy-onan* (Sessio Adamnani) in the county of Meath. In the parish of Aboyne, in Aberdeenshire, the final *t* of the word *saint* is added as the initial of his name; and Adamnan appears under the disguise of *Theunan;* and in other parts of Scotland we have *Teunan* and *Thennan;* and with a still further change, *Skewlan;* we find also the forms *Eonan* and *Fidamnan.*

These errors have led to serious confusions of history, and have misled some very high authorities. Thus, even Sir James Ware distinguishes between St. Adamnan and St. Eunan, making the latter the first Bishop of Raphoe—although there is no evidence from any ancient record of the existence of such a personage—nor was St. Adamnan ever a bishop. But, what is still more singular, the imaginary St. Eunan's day has been kept on the 7th of September, as the patron saint and Bishop of Raphoe, whilst the real St. Adamnan's day is the 23rd; and Dr. Reeves shows that one highly respectable writer divides the saint into three, giving St. Eunan at September 7th, St. Adamnan and St. Thennan at September 23.

Errors such as these may seem to some trivial, but it is impossible to overrate the importance of correcting them; they are corruptions at the very fountain-head of history; they lead to a confusion that propagates itself and generates other more serious errors. Important, however, as these corrections are, they are far from being any measure of the value and interest of Dr. Reeves's notes; I regret that time will not permit me to go into further particulars; but I must stop to call the attention of antiquaries to the note in which Dr. Reeves has given a list of the various

articles which tradition represented as having been in the possession or in the use of St. Columba: the great Altar Cross, said to have been sent him by Pope Gregory the Great; the Cathach, which may be seen in our Museum; the Cochall or cowl of the saint; the Cuilebadh, or Cuilefaidh, probably his tunic; his Delg or brooch; his great Bachall, or pastoral staff; the Bachall he gave to St. Centigern when they exchanged croziers; the Gospels of St. Martin of Tours; the two Evangelistaria, called the "Book of Durrow," and the "Book of Kells," now in the Library of Trinity College, Dublin; the Misach, now in the possession of St. Columba's College; and many other similar relics,—bells, consecrated stones, and croziers, which were supposed to have been connected with his history. Some of these, as we know, still exist; and the great value of such an enumeration of them as Dr. Reeves has given, is, that it may possibly lead to the discovery, or identification of others of them, if they should still peradventure be found on the Continent, or in the possession of some obscure or private person.

Dr. Reeves is the author of several other publications of great interest to the Irish antiquary and historian. The able description of the Bell of St. Patrick and its shrine; the Visitation of Archbishop Colton, of the diocese of Derry; the "Ecclesiastical Antiquities of Down and Connor;" and we may shortly, I hope, expect from him the "Book of Armagh," with a valuable dissertation on its contents.

Having given you this short and very imperfect account of the grounds upon which the Council have awarded the Cunningham Medals on the present occasion, nothing now remains for me but the very grateful duty of presenting the Medals to the gentlemen who have so well deserved this high distinction. I regret, however, to say, that two of those gentlemen are unavoidably absent,—Mr. Cooper having been detained in London by his Parliamentary duties, and Dr. Wall being prevented from being present by his advanced age, and the inclemency of the weather. Mr. Cooper, however, has deputed his distinguished assistant, Mr. Graham, to represent him on this occasion; and I have requested Dr. Butcher, the Regius Professor of Divinity in the University, to receive the Medal for Dr. Wall, and to convey to him my regret that I could not have the pleasure of delivering it into his own hand.

The President then, having called forward Mr. Graham, said:—

"Mr. Graham, although every one here must lament the unavoidable absence of Mr. Cooper, there will, I think, be equal unanimity in feeling that no more worthy substitute for him could have been found than yourself. To your exertions is due much of the merit of the work to which this Medal is awarded, and it is with great pleasure I deliver it into your hands. Mr. Cooper, in conjunction with another eminent Member of the Academy, has won for Ireland the proud distinction, that on her distant shores the zeal of two private individuals, out of their own private means, has done more for the advancement of practical astronomy than in other countries of Europe has been effected with the aid of Government patronage and public funds."

Mr. Graham then thanked the President for the allusion he had made to his own share in the work, for which this Medal had been awarded, and added :—

"I have been requested by Mr. Cooper to express his great regret that the very short adjournment of the House of Commons for Whitsuntide has prevented his attendance here this evening, to offer his personal thanks for the high honour conferred upon him.

"That regret is increased on account of the two facts that you, Mr. President, are connected with the county in which the labour has been performed that has elicited your approval, and that this meeting is honoured by the presence of the representative of her most Gracious Majesty.

"I am also desired to add, that Mr. Cooper has never considered himself more than a quarrier of stones or a hewer of wood for the scientific temple, but that he cannot deny that he has been anxious for, and received far beyond his deserts, encouragement in his pursuits from the master-builders of this eminent Academy."

The President then called upon Mr. Salmon, and said :—

"Mr. Salmon, I have to apologize to Mr. Cooper, and more especially to yourself, for the very imperfect account I have given to the Academy of your labours. But you know that for many years my studies have been directed to other subjects, and that I have given no portion of my time to practical astronomy, or to the higher branches of mathematics, in which you have so eminently distinguished yourself. Nevertheless, I retain enough of my former knowledge to appreciate very fully the merit of your works; although I confess that, without the kind assistance I have received from two of our brother Fellows, I could not have given to the Academy even that very inadequate account of your and of Mr. Cooper's researches, for which I feel that I owe you this apology. Accept, however, this Medal as a mark of the high approval of the Academy; and believe me, that it is no small gratification to myself personally to be the official medium of presenting it to you."

The President then called upon Dr. Butcher to receive the Medal awarded to Dr. Wall, and said :—

"Dr. Butcher, you, who are so well aware of the intimate friendship (and friendship is too cold a word), which exists between our venerable Vice-Provost and myself, will easily believe that the gratification with which I ask you, on the part of the Academy, to deliver to him this Medal, is only alloyed by his own absence. It would have been a real pleasure to me, and I think I may say to every Member of the Academy, to have seen him receive it in person. It is not often that a man who has reached the scriptural limit of human life is called upon before a Society like this, to receive a Medal for his literary exertions; but it is still more rare, that a man, after having reached that advanced age, should have produced a work of great originality and acuteness,—a work of which it is not too much to say, that it opens up new fields of thought and of research to all students of Biblical criticism."

Dr. Butcher returned thanks on behalf of Dr. Wall, and promised to convey to him the President's message.

The President then called upon Dr. Reeves, and said:—

"I have no small pleasure, Dr. Reeves, in presenting to you this well merited reward of your labours. Accept it as a testimony from this Academy to the great value of your writings, not only from their intrinsic merit, and the additions they have made to our historical and antiquarian knowledge, but from the tone and style in which they are composed, which render them models to be imitated by all who would labour with profit to themselves and others in the same field of learning."

Dr. Reeves returned thanks.

A vote of thanks to the President for his Address was proposed by his Excellency the Lord Lieutenant, seconded by Sir William Rowan Hamilton, and passed unanimously.

The Academy then adjourned.

DUBLIN UNIVERSITY ZOOLOGICAL AND BOTANICAL ASSOCIATION.

FRIDAY EVENING, APRIL 16, 1858.

Robert Harrison, M. D., Professor of Anatomy and Lecturer in Zoology, in the Chair.

The Minutes of last Meeting having been read, were approved of, and signed by the Chairman.

The following paper was read by William Archer, M. R. D. S.:—

SUPPLEMENTARY CATALOGUE OF DESMIDIACEÆ FOUND IN THE NEIGHBOURHOOD OF DUBLIN; WITH DESCRIPTION AND FIGURES OF A PROPOSED NEW GENUS AND OF FOUR NEW SPECIES.

On a former occasion I had the pleasure to read to this Association a Catalogue of Desmidiaceæ found by me in the neighbourhood of this city, which the Council did me the honour to print in the Proceedings. It is now my privilege to be permitted to follow up that list with a supplementary one, containing such additional species as resulted from some gatherings made during the last summer, and, in addition to the species hereafter to be enumerated, which are contained in Ralfs' "British Desmidiæ," to bring to notice and to describe four new species; and, although two of them are very minute, and the others not so striking as many of the other members of this interesting group, I do so with the hope that these additions to our Flora may be to some not without their interest.

For the reception of two of the new forms to which I think I am the first to direct attention, I now venture to form a new genus; and, while opposed (as I should undoubtedly be) to the formation of unnecessary generic characters and names, I do not think that in proposing a new genus, I have, in the present instance, fallen into so grave an error. I admit I am myself inclined to think it true that genera, like species, have an existence in nature,—an opinion held, I imagine, by the minority; however, there can be no doubt that many of the genera of our systems cannot be strictly natural, and this perhaps sometimes arising from a desire to divide into two or three other genera, possibly a good and natural genus, merely because, containing numerous species, it is thought too cumbrous and unmanageable, or from the natural and true characters limiting each genus not having been arrived at. In the Desmidiaceæ the distinctive characters of the genera are usually sufficiently well marked and decided; while, with two exceptions of genera, each containing only one species, they are formed of often numerous species, embodying and presenting, in, generally, an obvious manner, the characters of the genus under which they fall. I think, then, it is repugnant to a proper classification to unite in any genus, the species of which in an evident manner, by the possession of common characteristics, form a natural assemblage, one or more other species (although as a matter of course there must be minor points of affinity) which positive and negative characters of form and habit, it may be slight, but decided, and not held in common with the true species of the genus, exclude from being therein embraced.

A belief in the correctness of the opinion I here endeavour to express has emboldened me to the step which in this paper I now venture to take, in an attempt to form a new genus, and which I do with much diffidence; for, being wholly without the guidance of any of our masters in the study of these minute Algæ, or the benefit of their opinion, I would put forward the following, rather as suggestive than conclusive, more in the hope of, perhaps, ultimately eliciting information and correction, than as indisputably settling the position of the forms presently to be described.

It will, perhaps, be more convenient that I first proceed to describe the new forms which I have met with, one of which belongs to the genus Sphærozosma, another to Staurastrum, while the remaining two fall under the proposed new genus; and then to enumerate the species as described in Ralfs' monograph supplementary to my former catalogue, including therewith those species now for the first time noticed.

Before drawing attention to the new forms, however, it has been suggested to me, in deference to those of this Association (as well as to those who may hereafter favour this paper with a perusal) who, not having immediate access to Ralfs', or the "Micrographic Dictionary," &c., or not having directed their attention to the organisms themselves, may be comparatively unacquainted with the Desmidiaceæ, or kindred minute Algæ, that a short account of their nature and position in the vegetable kingdom may not be uninteresting; and while endeavouring

to do so I have to apologize to those to whom this sketch will, I fear, prove tiresome and dry, from being to them so familiar, because so devoid of novelty or originality. I hope, then, that those who have made these or kindred forms a study will bear with me while I try, as briefly as I can, to put together a short description of the appearance, nature, and position of the group to which I have, on the present occasion, the pleasure to add some new species.

The name "Desmidiaceæ" (taken from the genus Desmidium, considered as typical), is applied to a group of microscopic organisms, undoubtedly a family of confervoid Algæ, though, at first, they were associated with their kindred family, the Diatomaceæ, as one group, considered by Ehrenberg and his school as animalcules,—and, indeed, I believe I would not be wrong if I stated that they were still so considered by that illustrious observer. The definition of the "Diatomaceæ" is given in Lindley's "Vegetable Kingdom" as follows:—"Crystalline, angular, fragmentary bodies, multiplying by spontaneous separation"—and of the group so defined the Desmidiæ were made a sub-order, distinguished from the "Diatomeæ" proper, and characterized as "cylindrical." To any one at all acquainted with these two groups of organisms, it appears to me that the foregoing definition will not be satisfactory. I believe most modern authorities concur in the opinion that the Desmidiaceæ are entitled to rank as an order of Algæ, separate from but related to, the Diatomaceæ, which latter order is thus defined by the late Professor Smith:—"Plant a frustule, consisting of an unilocular or imperfectly septate cell, invested with a bivalve siliceous epidermis. Gemmiparous increase by self-division, during which process the cell secretes a more or less siliceous connecting membrane. Reproduction by conjugation and the formation of sporangia." Various species of the large group, thus accurately characterized, are met with in every ditch, pond, and stream, and in the sea, some of them very common, whilst others occur rarely. They are microscopic cellular organisms, free or attached, occurring singly or enclosed in gelatinous tubular investments, the individual frustules with yellowish or brownish contents, and provided with a siliceous coat, which may be broken, but not bent, and composed of two usually symmetrical valves with a connecting band at the suture, the siliceous coat or shell remaining permanent after the organic contents have perished, and often possessing minute and elegant markings. They are endowed, many of them, with a power of motion, and when this was supposed to be peculiarly an animal function, it is not surprising that these beautiful organisms were referred to the animal kingdom. They are, however, now almost universally, and there can be no doubt correctly, esteemed to belong to the vegetable world, but into the discussion it is not the province of this slight sketch to enter.

It is now my duty to revert to the kindred order, Desmidiaceæ. Whatever doubt may have existed as to the true nature of the Diatomaceæ, I am somewhat at a loss to see how there could have been any hesitation with regard to the vegetable nature of the Desmidiaceæ. In the highest and most recent authority we have on these organisms, Ralfs'

elegant monograph,—they are thus defined:—"Fresh-water figured mucous and microscopic Algæ, of a green colour; transverse division mostly complete, but in some genera incomplete; cells or joints of two symmetrical halves, the junction always marked by a division of the endochrome, often also by a constriction. Sporangia formed by the coupling of the cells and union of their contents." These are microscopic gelatinous organisms, of a green colour, growing in fresh water only, the cellulose walls of which are covered with "pearly granules," or minute puncta, or asperities, or are smooth, without any siliceous coat, of peculiar and varied forms, such as oval, lunate, cylindrical, triangular, or compressed, &c., usually with variously formed rays or lobes, or quite simple, presenting a bilateral symmetry; the junction of the halves marked by a division or interruption of the green contents, often, though not always, by a constriction of the frond itself; the opposite valves connected by a suture; the individual cells either free, arranged in linear series, forming a filament, collected into faggot-like bundles, or disposed in circular, flattened, star-like groups. It will be seen that the most striking points of distinction from Diatomaceæ are the absence of the siliceous figured coat, and the contents being green, not brownish or yellow. The Desmidiaceæ are very striking objects under the microscope, from the singularity and variety of their forms, and their curious external appendages and lobes. That which is most distinctive and characteristic in their appearance is their bilateral symmetry, usually, though not always, accompanied by a more or less deep constriction between the segments of which each cell is composed. But in these respects there exists all shades of difference in the various genera. For example, in the genus Scenedesmus the symmetrical outline is wanting; in Pediastrum it is indicated by an external notch on the outside only; in Closterium and Penium, as well as in a new form I have the honour in this communication to bring forward, there is no constriction (nevertheless the tendency to the bilateral division is indicated in those forms by the usual pale band at the centre of the endochrome); in Hyalotheca, various Cosmaria, Tetmemorus, &c., the constriction is but slight; in Desmidum and Didymoprium it is indicated by only a notch at each angle; while in various other genera the constriction becomes deeper and more obvious, until at last in Sphærozosma, Euastrum, Micrasterias, &c., the constricted portion becomes like a mere isthmus between the segments, giving them the appearance of distinct cells, and as such they were formerly considered. Each frond or individual, however, is always a single cell, as is often evidenced by the whole contents escaping through a single accidental rupture. The cells frequently possess warty or spinous processes, and the cellulose coat often presents minute markings or puncta, caused by the presence of little elevations. The cells are usually more or less surrounded by a gelatinous sheath,—in Hyalotheca, Didymoprium, and many others, this is well defined, but in some species it is so attenuated as to have its existence made known only by the gelatinous investment preventing the contact of the fronds. The contents of the cells of the Desmidiaceæ appear to be similar to the green

confervoids generally, that is, protoplasm coloured green by chlorophyll, and entirely enclosed in a "primordial utricle," which organ appears more evident as a real and distinct *utricle* than in any other vegetable cells I have seen. The contents of the cells often contain starch granules. A circulation of their fluid contents has been noticed in various species; in Closterium and Penium, &c., it is of a very remarkable character. In *Cosmarium Ralfsii* (*Bréb.*), after the contents had lost their characteristic somewhat radiate appearance, and had become broken-up, I have seen a regular current rotating somewhat rapidly round-and-round the internal margin of each segment, and carrying the chlorophyll granules with it, very strikingly like that in Anacharis, &c.

The ordinary mode of multiplication of the individual cells is by repeated transverse division, which is effected by the interposition of new growth between the original segments, the older segments remaining unaltered, except (when they remain for some time attached) by being pushed asunder by the enlarging young segments. The exact manner in which this takes place differs slightly in detail in the different genera. In Closterium, which in the various species is more or less of an arcuate or lunate form, the original cell acquires a constricted appearance at the middle; a separation of the endochrome having taken place, the new constriction gradually becomes deeper, until at length it is complete, when ultimate somewhat sudden separation is effected by a from-side-to-side sawing motion of the segments, which is highly curious to observe; the blunt convex new end of each now separated individual cell afterwards grows out, till the symmetrical more or less attenuated arcuate form of the frond is restored. Although I have not witnessed it in *Penium digitus*, I am greatly inclined to think that the mode described in Closterium holds good in this species. In *Penium Brébissonii*, although it doubtless follows the same rule as the other Desmids, the mode of increase can hardly be distinguished, and some botanists have included that species amongst the Palmellaceous Algæ; but its central pale space and elongate form easily distinguish it. In such bipartite forms as Micrasterias, Euastrum, Cosmarium, Staurastrum, &c., to produce two exactly similar fronds from one, it is obvious that two new segments must be formed; but in these the growth of the new segments takes place, always to some, and often to a considerable, extent before their separation. The constricted portion of the old frond expands by the formation of a connecting tube, "of which the interposed new coat is the direct continuation of that which lines the internal surface of the cracked halves of the old shell" (Hofmeister),* and which is soon dilated into two globular or roundish enlargements. These are the rudiments of the two new segments, which soon increase in size, and in doing so push asunder the two older segments, acquire colour, and ultimately assume a like appearance, with all the characteristic lobes, sinuosities, or processes of the species, similar to those pos-

* Translated in "Annals of Nat. Hist.," third series, vol. i., No. 1, January, 1858.

sessed by the older segments. Plate XXI., Fig. 12, happens to afford an example of this. I have seen this process of division in specimens of *Micrasterias rotata* (obtained with the division just commenced), accomplished in between twenty-four and thirty-six hours, at the end of which time separation had taken place, the new segments being of full form and dimensions. In the free genera they are at length disconnected, each new segment bearing with it the old one, thus producing two distinct fronds, and when this transverse division is incomplete a filament is formed. This mode of division does not appear to differ essentially from that which holds good in other Algæ, and seems to be only a necessary modification resulting from the exigencies produced by the constricted form of the cells; while it does not appear improbable that other Algæ not Desmidian may have a like mode of cell-increase.

The mode of true reproduction in the Desmidiaceæ is by conjugation, very like the same process in the Zygnemaceous group of Confervoids. This process consists essentially in the pouring out and amalgamating of the contents of two distinct cells, resulting in a definitely formed spore or sporangium; and in the different genera of Desmidiaceæ presents some slight modifications. In the filamentous forms, such as Hyalotheca, Didymoprium, &c., conjugation does not take place till the constituent joints of the filament become disunited, apparently any two of which meeting in the water, couple and blend together their contents, the old cell-wall of each pair of conjugated joints remaining, as it were, fused together, and surrounding the sporangium. In Closterium, Penium, Cosmarium, Staurastrum, &c., the free cells conjugate in pairs. In them the process differs somewhat from that which takes place in the Zygnemaceæ. In that group, the cells of two filaments lying side-by-side, bud-out, as it were, pouch-like protrusions towards each other, which, meeting half-way, become inosculated, forming ladder-like transverse tubes between the connected filaments; the contents of each conjugated cell of one side either pass over by the transverse tube into the cavity of the opposite cell, or the contents of each meet half-way in the centre of the connecting tube, and in either case become ultimately massed together into a rounded compact spore. In the most of the Desmidiaceæ there is no transverse tube formed; but the fronds about to conjugate approach and dehisce by the transverse suture, and each pours out its contents in one mass into the water, which, gradually becoming consolidated with the contents of the other conjugating individual, assumes a membrane, and becomes a perfect sporangium, surrounded by gelatine, and destined for reproduction. The sporangium, which is usually spherical (sometimes quadrate) either remains smooth or ultimately by degrees produces, in every direction from its surface, variously formed spines or forked processes, and bears, in this state, no resemblance to the parent species. Plate XXI., Fig. 13, is an example. Any observations that have been made in regard to the subsequent development of the sporangium go to prove that its contents ultimately give birth, by binary segmentation into a definite number of portions, to forms which at first are very minute, but when set free by the solution of the wall of the spo-

rangium, afterwards attain the size of the parent species. We have, in an interesting account by Hofmeister, lately published (*loc. cit.*), a description of the germination of the sporangium of *Cosmarium tetraophthalmum* (*Kg.*); and of the evolution therefrom, by segmentation of its contents, of a brood of eight or sixteen young Cosmaria, and which, according to his statement and figures, more resembled *Cosmarium Meneghinii* (*Bréb.*) than *C. tetraophthalmum.* His observations do not appear to have been continued long enough to prove that these young Cosmaria ultimately grew into the mature form of *Cosmarium tetraophthalmum;* but there can, I apprehend, be no doubt they did, or would have done, in their native habitat. It might, perhaps, hence appear probable that *Cosmarium Meneghinii* is not a true species, but only the young state of *C. tetraophthalmum.* However, if it indicate, as I should suppose it does, that when a Desmid repeats itself by transverse division, it has attained the mature size and form of the species, *then* must *Cosmarium Meneghinii* be considered a good species, for I have myself met it in a divided state. If this be so, then I apprehend all that can be inferred is, that the *young* state of *Cosmarium tetraophthalmum*, immediately upon development from the sporangium, greatly resembles the *mature* form of *C. Meneghinii.* A very similar observation by Mr. Jenner on the sporangium of *Closterium acerosum* (*Schrank*) is described and figured in Ralfs, but in this case the young brood were miniature resemblances of the mature form of that species. The sporangia of the Desmidiaceæ, as well as the similar productions in other Algæ, appear to be endowed with the power of remaining dormant for a length of time (which is, perhaps, sometimes of some considerable duration) before their vegetative activity is aroused, and this probably occasionally under a state of dryness which would be fatal to the parent species. The following-out of the development of the sporangium appears very difficult; seldom is the happy opportunity presented to the observer. I have myself repeatedly had the sporangia of several species, sometimes abundantly; and while I have been able to trace, for my own satisfaction, their formation (in *Arthrodesmus incus*) from the first approach of the parent fronds to conjugate, to the ultimate perfecting of the fully formed sporangia, they, however, in all cases, perished before any alteration in their appearance took place.

A mode of propagation by unquestionable zoospores has been noticed and described by Alexander Braun, in Pediastrum.* The zoospores, in this genus, do not escape separately, but are emitted *en masse*, still inclosed in the inner membrane of the parent cell, within which, however, they exert a vigorous movement, and involved still in which they settle down, and arrange themselves in a flat cluster, resembling that from one cell of which they originated. But a more general increase by zoospores has been attributed to the Desmidiaceæ, but I cannot find it corroborated by *direct observation* that this actually takes place. Certain it is that a peculiar motion (or commotion) of the granular contents not uncommonly

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* "Rejuvenescence in Nature," Ray Soc. Publication, 1853.

occurs, and this more especially (in which my own experience confirms Mr. Ralfs'), in specimens which have been kept some time in the house. These minute moving bodies are apparently formed of the cell-contents disintegrated and subdivided into an immense number of granular particles, and which exert an active, vigorous, tremulous, dancing kind of motion, as if each one were elastic and perpetually meeting with something to make it rebound, and as quickly stopped only to meet with another impulse, resulting in little or no actual change of position of the individual particles, notwithstanding all the commotion. I greatly fear this fanciful description will hardly be intelligible; indeed I think this peculiar phenomenon thus attempted to be described must be witnessed to be comprehended. These moving granules have been assumed to be zoospores, but the phenomenon may be due, possibly, to some sort of "molecular motion." I have myself seen it in numerous genera and species. Mr. Ralfs suggested that they (the agitated granules) are zoospores, and says they occur when the cell approaches maturity. Dr. Carpenter calls them such, and says they *may* be ciliated; but without giving authorities. I have seen this curious movement in cells undergoing division, and as active in the young and as yet unformed segment of a frond during division as in an old fully developed one. I have noticed, too, a precisely similar movement in the germinating spore of an Œdogonium. To my eyes this "swarming motion" does not resemble that of the true zoospores of Cladophora, or of other Algæ which give birth to undoubted zoospores. I have not seen anything to indicate cilia, with only a $\frac{1}{4}$-inch object-glass, however; and for my own share I believe the nature or import of this curious motion is undecided, and I should be glad, indeed, to meet with any observations which would throw light on this phenomenon, while, upon this point, as on many others, it would be as untrue, as it would be unbecoming, to avow myself as not open to conviction.

I have before stated that the Desmidiaceæ were formerly regarded as animals. The principal reasons advanced by the Ehrenbergian school for surrendering this group to the zoologist, are, that they exert a *voluntary motion;* that they increase by transverse self-division; and that in Closterium there are at the extremities apertures and protruding organs continually in motion. With regard to the first reason, it is clear that using the term "voluntary" is a begging of the question. That they move is beyond doubt, for these organisms, if buried in the mud, will come to the surface and become exposed to the light. While this is doubtless a highly curious phenomenon, it strikes me as not more remarkable than any flowering plant cultivated in-doors bending its leaves towards the window under the stimulus of light (not to speak of the vigorous movements of unquestionable plants high in the scale). As to the second reason, the increase by transverse self-division,—this is by no means an exclusively animal characteristic; the very same argument might, with greater force, be applied in proof of their vegetable nature, as I need hardly insist on. With regard to the third reason,—the various species of Closterium have been too often made the subject of examination by numerous observers to allow of terminal apertures

and protruding organs not having been seen, if they really existed. There can be no doubt that they do not. At each extremity of the Closteria, however, there is a distinct chamber or space containing active moving granules constantly flitting about; what they mean, or what their purpose or import, is as yet unexplained. It may be that they are merely passively tossed about by the eddy which is likely to be produced by the conflicting currents of protoplasm, which are so evident and so curious in Closterium. But a very similar circulation occurs in *Penium digitus*, but here, notwithstanding the current, there is no open clear space at the ends containing moving granules. In that species, however, there are moving granules to be seen travelling over the surface of the mass of endochrome, which sometimes make their way down the frond, at one side, to the end, where they follow its curve and come up by the other side, which looks like as if these granules were carried by the current, which is, however, apparently of an irregular character like that in Closterium. But, again, it is no uncommon thing to see the broken-up granular contents of a Closterium pressed-out upon a slide, to exhibit the same agitated dancing motion as a few possessed within the living frond; and I have seen (it was in *Closterium lanceolatum*), in a specimen from which the contents had nearly all been pressed-out, leaving only comparatively a very small quantity within the ruptured frond, the (as yet) contained granules flitting about quite like the few terminal ones in the normal state. Very little actual change of position, however, was effected on the part of any of these granules, except by a few which happened to lie at one side of the frond. These were (as it appeared to me) guided along by their happening to be in this position, and effected sometimes a somewhat considerable onward motion. The whole thing struck me as forcibly resembling the terminal space, enlarged as it were by the withdrawal of the great mass of the endochrome, and only leaving behind enough of the disintegrated cell-contents to furnish a somewhat evenly distributed crowd of granules moving, their only definite boundary being now the external wall of the frond, and not, as in the normal state, a little cavity or chamber, excavated, as it were, out of the endochrome. A very similar movement occurred amongst the pressed-out granules, but probably, on the whole, not so active as that noticed in the still contained granules. I apprehend this phenomenon must have been due to "molecular motion," for the current even within the frond must have been, of course, wholly destroyed, which, even did it exist, would be hardly likely to produce their curious dancing motion; and if the pressed-out contents exhibit motion in obedience to that curious law, I should imagine that the granules normally disassociated from the endochrome within the living frond cannot be exempt from it, and which may account in some measure, in conjunction with the circulation possibly, for the remarkable movement noticed in the Closteria. The "swarming motion" before alluded to as occurring in many species may be a movement of a similar nature; it is, however, more vigorous and active than that which is noticeable in the pressed-out cell-contents in the ordinary condition. I shall presently advert to

this phenomenon of moving granules as displayed by my new form. The foregoing are the principal arguments for the animal nature of these organisms, which clearly do not hold good. On the other hand, the arguments in favour of their vegetable nature are more numerous and convincing. The cell-wall composed of cellulose, the presence of starch, the multiplication of the cells by transverse division in a manner analogous to other Algæ, the reproduction by conjugation and formation of sporangia similar to other Confervoids, their herbaceous green colour owing to the presence of chlorophyll, the rotation of their cell-contents, &c., all combine in proving their vegetable nature. Nor are special points of affinity wanting with various neighbouring groups of Algæ, irrespective of the Diatomaceæ. For instance, they approach the Palmellaceous Algæ by their gelatinous nature and likeness of form in some species of Penium; to the Ulvaceous Algæ they approach through such as *Scenedesmus obtusus*, connected with Merismopædia; Spirotænia considerably resembles a joint of Spirogyra; while a form to be brought to notice presently and its congeners point, I apprehend, to the Zygnemaceæ.

The Desmidiaceæ occur in shallowish, undisturbed ponds in open exposed situations, such as little pools on boggy moors and commons, permanent ponds in old quarries, &c. A few are met with in gently flowing water. They are either mixed imperceptibly with the mud, or disposed in a green stratum on the bottom, or projecting in little tufts, or floating in little gelatinous masses on the surface, or forming a cloud-like mass investing the submerged leaves of aquatic plants, or sparingly scattered amongst the masses of filamentous Confervoids. Several species are quite common, but as a group they are more local in their distribution, than, as a group, are the Diatomaceæ, the commoner species of which occur almost universally.

Having thus tried, as briefly as I could, to communicate an epitomized account of the nature and appearance, and of the distinctive characters of this group of Confervoid Algæ, and because an explanation seems to be due for obtruding so much that is not new, I would beg again to remark that I have undertaken it for the use only of those of our members who may be unacquainted with the facts and details brought forward. I will now pass on to describe my new forms, being that portion of this communication to which any interest will be likely to attach on the part of those who are experienced.

I have now to bring to notice an Alga which, to the naked eye in the mass, and perhaps at first sight under the microscope, does not at once strike the observer as belonging to the Desmidiaceæ. The organism in question forms rather dense masses of filaments, sometimes an inch or two or more in length, attached to aquatic plants, and, in the mass, is of a bright and beautiful green, and of an elegant appearance, like "floss silk" in the water. When placed under the microscope, the filaments are seen to be composed of very greatly elongated joints, of moderate diameter, with truncate ends, and possibly might, at a hasty glance, be taken for a Mesocarpus, or some allied form. Probably the first circum-

stance which attracts notice, in addition to the remarkable length of the cells, is the presence of a narrow pale band, or interruption of the endochrome at the centre of each joint, which fact appears to me sufficiently significant to indicate that towards the Desmidiaceæ we are to look for its affinities. I will try briefly to describe a joint more closely. Each joint in proportion to its breadth is extremely long, sometimes, though rarely, as many as forty times, averaging, perhaps, from twenty to thirty times longer than broad, and it is nearly cylindrical and quite smooth. (See Plate XXI., Fig. 1.) There are two points of view from which a different aspect of the cell-contents is obtained, from the fact of the endochrome being disposed in a longitudinally compressed or flattened band. When the broader diameter of the endochrome is towards the observer, it is seen to fill the entire width of the cell, and having, as before adverted to, a narrow, transverse, pale space at the centre (separating the endochrome into two equal portions), sometimes band-like, but more frequently circular, from the endochrome terminating at each side with a concave outline. There is a single central longitudinal series of "vesicles" (or bodies similar to those in Closterium, &c.), reaching from end to end of the endochrome, and disposed at intervals of somewhere about the diameter of the joint, one of these always occupying the centre of the pale space. The bodies which, following the name used by Ralfs for similar appearances in Closterium, &c., I have just called "vesicles," I believe are not truly *vesicles*, but solid bodies, or corpuscles. Pressure upon the joints obliterates, or rather hides them, causing the endochrome, which before was apparently of an uniform character, to assume a granular appearance; while a still greater force upon the pressed-out cell-contents, now become somewhat scattered-about, shows these globular bodies, perhaps some not much altered, others cracked or split, and others in fragments (Fig. 4). If these were truly "vesicles," or if they were vacuoles, I do not think this appearance could result. Were they vesicles, I apprehend that, by careful manipulation, they should be capable of being pressed out either in a collapsed or burst state. Were they vacuoles, I should imagine that pressure would only efface them, and that they would hardly be found in the mass of extruded endochrome, whereas in reality pressure cracks and breaks them, as before stated, into fragments. I think, then, that the endochrome is at first of a very finely granular nature, so as to appear homogeneous, or uniform, when fresh, with this median series of firm corpuscles imbedded, which are spherical, and of a smooth and well-defined outline. They are, I should think, granules of chlorophyll, of a firmer texture, but of a lighter colour, than the remaining endochrome. That they might occasionally contain starch is, I suppose, probable. I tried the application of iodine, but without being able to see the characteristic tint of starch,—the whole plant being stained a yellowish-brown, while the central corpuscles became very much darker than the other part of the endochrome. At each extremity of the joint the endochrome becomes more or less retracted from the end of the "primordial utricle," leaving a clear space, which, in cells just after division, is very small, but which afterwards becomes greatly larger. Within

this clear space several active granules may be seen in constant agitation, like those in Closterium, Docidium, &c., though there does not appear any special chamber, as it were hollowed out of the endochrome, containing the moving granules, as in those genera. These were more numerous and more evident in the fresh specimens some five or six months ago, when I first noticed this plant, than they are in specimens gathered during the winter. Of these active granules I have remarked sometimes one or two in some specimens notably larger than the others, and I have noticed the granules continue their active motion in the water for some time after being set free by the forcible fracture of the cell, as will presently be again alluded to. If the joint under examination be now caused to make a quarter of a revolution on its long axis, the narrow or side view of the compressed endochrome becomes turned towards the observer, and consequently presents a different aspect (see Fig. 2). The outline of the endochrome, now brought to view, is seen to be somewhat undulatory or waved, owing to the mass of endochrome closely embracing the central row of light-coloured corpuscles which are still distinctly visible, so that at the regular intervals of their occurrence they form slight protuberances or distentions of the compressed band of endochrome, which at this edge view does not fill more than about a third of the diameter of the cell. I have sometimes noticed (but rarely, however) each half of the endochrome to be turned a different way with regard to the other, or at right angles, that is, one half presenting the broad view simultaneously with the other showing the waved, compressed, lateral view, which conditions were of course reversed on the joint being caused to turn longitudinally one quarter of a revolution. I have once noticed one half of the band of endochrome to be, as it were, *twisted* upon itself. The transparent pale space, due to the suspension of the endochrome, is again manifest at this edge or lateral point of view, when it is also seen that each half of the endochrome does not approach the other directly straight, but, at a short distance from the central clear space, they are each somewhat suddenly curved towards each other, and towards the boundary wall, to which they approximate closely at the *same* side. I have only once or twice seen the base of each half of the endochrome curved towards the cell-wall at opposite sides. Of course the transparent space at each end of the endochrome, bounded by the primordial utricle, is equally apparent in the present view as it was before, and the active granules can be equally well seen exerting their curious motion; and in addition, owing to the compressed and narrow mass of cell-contents leaving a considerable space, they can not unfrequently be seen at a distance from the end of the joint swimming up and down with a tremulous, agitated, fluttering, uncertain motion. Occasionally one can be seen, having travelled up the length of the joint, to escape into the terminal space and join in the active dance of the other granules. Even at the view of the joint, first adverted to (Fig. 1), which exposes the broader diameter of the band of endochrome, and which leaves no room for them at the side between it and the outer wall, these wandering granules can, with certain illumination, be seen like darkish specks moving

about, as it were on the surface of the endochrome. They are, doubtless, identical in nature with the similar active granules in Closterium, Penium, &c. I have not been able to detect any appearance indicative of the occurrence of a circulation, except it may possibly be inferred from the up-and-down movement of these errant granules. But then, when the cell is broken by force these active granules appear to be more numerous, apparently arising from similar granules becoming disengaged by the pressure from the mass of endochrome, and themselves setting-up a movement in the surrounding water, of the same quivering, agitated character (Fig. 4). Those who have seen the "molecular" movement of the granules of the fovilla of pollen will, to my mind, have a better idea than I could convey of the appearance presented by these moving granules when pressed-out, only they are not so numerous. Perhaps there may be a current within the cell, and that the fluid contents between the mass of endochrome and the margin of the cell may be of too great tenuity to enable it to be detected; at all events, I have not seen any of these free granules carried directly and steadily onwards, similarly to what occurs in other vegetable cells. I apprehend, however, that the curious "molecular" movement displayed by the *pressed-out* granules is only just a continuation of the *same* movement to be seen *within* the joint, and that the additional granules moving about when forcibly expelled would have also moved in the same manner inside, could they have been disassociated from the mass of endochrome *in situ*. When by violence one of these joints is broken, the separation takes place by a suture at the centre over the pale space, and by a smooth line of division.

Of such joints as I have thus endeavoured to communicate an idea are the filaments composed of which the plant is constituted, and which for some time, attached to aquatic plants, maintain their connexion as a filament (Fig. 3). There does not appear to be any dilated or scutate base by which the first joint is attached to the foreign objects, but on which the filaments seem to stand directly, and with which the truncate apex of the first joint appears merely to be in apposition. The joints frequently separate, however, and can be met with in the water singly. Indeed, my first acquaintance with this organism was made with a single detached cell. They increase in length, too, sometimes after separation.

The division of the joints into two segments by a suture, although there is no transverse stria or other perceptible indication in the unbroken cell-wall of its existence, coupled with the interruption of the endochrome into two distinct portions, as well as with the active granules, seem at once to decide that this organism belongs to the Desmidiaceæ.

The particular mode of increase by cell-division which prevails amongst the other Desmids (by the formation of a septum and by the interposition of new growth between the old, unaltered segments pushing them asunder, and afterwards becoming divided at the middle, each half of the newly grown portion ultimately attaining the size and form of the old segments, and usually becoming cut off, and separation, taking place), I need hardly repeat, is abundantly evident and unmistakeable amongst the more elaborately formed bipartite genera; whilst

even in many of those of more simple, even cylindrical outline, there is often a difference of colour in the cell-wall marking the newly grown portion. For example, *Penium cylindrus*, in which the cell-wall of the older segments being reddish, the newly grown portion is well marked by its absence of colour. So also in Closterium and others. But in the form under consideration, the sides being parallel and straight, and the cell-wall destitute of colour, I do not see any *external* means of proving that the new growth of each joint takes place *only* between the older segments. In the bipartite forms (such as Micrasterias, Euastrum, Staurastrum, &c.), the mode of increase is *necessary* in order to restore the symmetry of the dividing frond; but the form in question being destitute of lobes, inflations, or processes, and straight, the normal symmetry of the cylindrical dividing joint is not disturbed. Nevertheless (while it seems to me that the characters before detailed are abundantly sufficient, in fact do prove, that this organism is a true Desmid, for it will be noticed that the mode of cell-increase referred to does not form part of Ralfs' diagnosis of the Desmidian group), though it cannot be deduced, from any alteration in the *outward* form of the joints, that the new growth takes place in the manner described, yet I think the following circumstance indicates sufficiently definitely that this is really the mode which holds good, and to my mind it leaves no doubt.

On looking over a mass of the filaments upon a slide, in by far the greater number of the joints it may be seen that the pale interruption of the endochrome occupies the centre of the joint, and is distant from each extremity precisely, or very nearly precisely, the same interval. But in a few cases, it may sometimes be noticed, that in two neighbouring joints of a filament the pale space is not central, but in both is very considerably nearer the adjacent extremities of the two contiguous joints. It will also be remarked that the two joints displaying this peculiarity are also shorter than the remaining joints of the same filament: Fig. 3, representing a few joints of a filament (magnified 200 diameters), shows at its upper part the state alluded to. Now I believe that this occurs in the following way. A septum is formed—as in the other Desmidians under the isthmus at the constriction—here, at the pale space in the centre of the cylindrical joint, which represents the isthmus in the bipartite forms. Close to this new septum, at *each* side, there now exists an interruption of the cell-contents forming the pale space, which, by the growth (perhaps pretty rapidly) of the interval between it and the lately formed septum, and by a fresh accession of endochrome, soon, in place of being, as hitherto, eccentric, becomes removed to its normal or regular central position; and this taking place in each joint, the equilibrium of both is restored, because, moreover, the segments remote from the new septum, in both cases, seem to remain unaltered. This is as precisely similar to the mode of increase which is usually seen, here and there, in a few of the joints in the filaments of *Sphærozosma vertebratum*, as is compatible with the great difference of the form of the joints in each species. In *Sphærozosma vertebratum* it is more apparent, because the constricted form of the joints renders it in-

evitable that the growing segments should be at first smaller and narrower than the older ones; in the form under consideration, however, the nascent segment has only to grow longitudinally to form a continuous cylinder with the opposite older segment. Having thus (at least to my own satisfaction), even without this last conclusive evidence, proved the form, of which I hope I have succeeded in conveying a satisfactory conception, to be a true Desmidian, of which group there can be no doubt it is a new species, I will now assume both these points conceded, when the next question becomes—to what genus of Desmidiaceæ does this plant belong? Confining our attention for a moment to a single joint, it might seem to possess as good a right to a place in the genus Docidium as *Docidium asperum* (*Bréb.*), as described in Ralfs, but I shall presently give, I believe, valid reasons, why I think neither of these organisms would be rightly placed in Docidium, and, if not in that genus, certainly not in any other known.

On a former occasion, when I had the honour to lay before the Association the first part of a Catalogue of Dublin Desmidiaceæ, I appended to the mention of *Docidium asperum* (*Bréb.*) a note of my having met that species forming short filaments. Now, I have since, on several occasions during last summer, met with it, and always forming filaments of indefinite length, but being usually mixed with other Algæ, never in very large quantity; frequently, however, detached cells occur, more especially when kept some time in the house. In addition to the fact of this species forming filaments, which is not alluded to in Ralfs, I have met specimens possessing, when fresh, in nearly every joint, a pale central space or division of the endochrome into two equal portions, and contracted in an irregular manner enclosing a single central series of corpuscles, somewhat like the side or edge view of the endochrome of the form to which I first directed attention, and sometimes disposed in a zigzag or subspiral manner, while possessing all the other characteristics, as described in Ralfs: I allude to the roughness, owing to minute scattered granules, and to the dilated extremities (Fig. 5). There can be no doubt whatever that it is the same plant. When a joint is fractured, it breaks at the middle, but not with so smooth a line of fracture as the before described form. There has also occurred to me another form nearly allied to *Docidium asperum*, but I believe a distinct species, being altogether a smaller and more slender plant, and of a different outline (Fig. 6). This form, too, occurs filamentous, but is very fragile. It differs from *Docidium asperum* (*Bréb.*) in each joint being fusiform, at the middle of which, where it is broadest, it is little more than one-half the diameter of that species, whence it gradually tapers towards the extremities, which become somewhat suddenly dilated, giving to the ends a slightly capitate appearance. It, too, is rough on the surface with minute scattered granules. I think this form differs materially from the variety of *Docidium asperum* figured in Ralfs after M. de Brébisson, which is quite as large a plant both in the diameter and length of the cells as that species, which are not at all fusiform, and differ only in the extremities being somewhat constricted beneath the apex. I have found this fusi-

form species also to present a central division of the endochrome, which is also of a contracted waved outline, enclosing a central series of corpuscles similarly to *Docidium asperum* (*Bréb.*), and to the first noticed species. In this species I have also noticed indications of the same mode of division as described and figured in the first form. There is no *perceptible* gelatinous sheath, so far as I can make out, surrounding any of these three organisms. I regret I have not been fortunate enough to meet with the reproductive state of any of them. If I might venture on a conjecture, I should probably say that it takes place by conjugation of the separated joints.

It will be by this time seen that the end at which I aim is to indicate that I think the first-described organism, *D. asperum* (Bréb.), and the fusiform species, belong to the same genus. It is true I have not been able to see moving granules at the extremities of *Docidium asperum* (*Bréb.*) nor of the fusiform species, although, on the authority of Mr. Ralfs, it is stated that M. de Brébisson has seen them in the former. For my part, I do not doubt that they may exist, for it seems to me that the rather opaque asperities which cover the surface of the joints may hinder them being noticed. I have sometimes *thought* I saw them, but could never feel positive. In any case I might remark that we have species of Penium both with and without active granules.

Assuming it as granted that these three forms belong to the same genus, it may be thought necessary to inquire, is that genus Docidium? I do not think so. In the first place, all these species *entirely want* any constriction at the centre of the joints, nor are the segments *at all* dilated at the base; both which are, as it appears to me, essential characters of Docidium, and which are very manifest in all the British species, as well as in the American, as figured in Ralfs. This, I admit, however, must be stated with one slight exception, for here I am not unmindful of *Docidium minutum* (*Ralfs*). In that species there appears a distinct central constriction, but there is no evident inflation at the base of the segments. There appears a terminal, well-defined cavity in which are moving granules, not as in the first of the new forms which I now bring to notice, a space, left merely by the withdrawal of the endochrome, in which these move. Moreover, *Docidium minutum* is *not* a filamentous form. Mr. Ralfs himself allows *Docidium asperum* (*Bréb.*) to remain in that genus unwillingly, and merely because he had no better course open. But perhaps it might possibly by some be urged that the essential characters of the genus Docidium might with propriety be altered by omitting those before mentioned, which seem to be abundantly sufficient to exclude the three forms in question; or some might say they might be kept in Docidium as aberrant members of the genus. It occurs to me that the answer to such suggestion is found in the fact of these three forms being *filamentous;* else we might with as great propriety and as good reason include, for instance, Sphærozosma with Cosmarium, or Desmidium with Staurastrum, the separated joints of which filamentous genera resemble the free genera Cosmarium and Staurastrum respectively, more than do the separated joints of the filamentous forms

under consideration resemble the apparently natural genus Docidium, as at present constituted. The same considerations will, I think, distinguish any of these forms from Penium. There is, perhaps, some resemblance, in a separated joint, to such forms as *Penium truncatum* or *Penium cylindrus*, but the ends in both these species are rather rotundato-truncate than truncate, while it seems that the affinities of Penium are rather with the Palmellaceous Algæ, through such species as *Penium Brébissonii*, whereas I apprehend the forms now described approach the Zygnemaceous Algæ.

These are, then, I believe, filamentous Desmidiaceæ, the individual joints of which bear some resemblance to Docidium (still less to Penium and Closterium), while the filament does not resemble any other established filamentous genus. I believe, then, the first described form must be taken as the type of a new genus, and which, so far as I know, will be the only example of a fixed or attached Desmid; along with which I would venture to associate *Docidium asperum* (*Bréb.*), and, as a matter of course, the fusiform species. To some it may, perhaps, seem premature to found a genus upon the characters presented by the mature form alone, without acquaintance with the reproductive state. But it will be recollected that none of the genera, according to Ralfs, are founded upon any appearance or phenomenon presented by the mode of conjugation, or form of the sporangium, and it is rarely employed as a specific character; and this, for necessary and obvious reasons: the sporangia of numerous species are not known, in many but rarely met with, while in the same genus considerable diversity sometimes occurs in the sporangium, such as the form of the spines and other particulars. For my own share, I do not see any course open but to make a new genus. From the simplicity of form, however, I have found some difficulty in drawing up concise characters: I trust, however, the following may be found to meet the requirements of the case:—

Class.—ALGÆ.

Order.—Chlorosporeæ or Confervoideæ.

Family.—Desmidiaceæ.

Leptocystinema (*nov. gen.*).

Plant an elongated jointed filament (often separating); joints straight, much elongated and slender, without a central constriction or inflation, entire, ends simply truncate, or dilated and truncate (no evident gelatinous sheath).

1.—*Leptocystinema Kinahani* (*nov. sp.*).

Filaments attached, frequently breaking up into separate joints, which are slender, extremely elongate, linear, cylindrical, and smooth, their ends abruptly truncate; the junction of the halves marked by a

pale transverse interruption of the cell-contents; endochrome forming a compressed longitudinal band, its broader diameter extending the entire width of the joint,—the narrower not filling more than one-third, and presenting an undulating outline,—at the extremities of the joint more or less retracted from the end of the primordial utricle, leaving a clear space, in which are active granules; the endochrome also having immersed within it a single longitudinal central series of light-coloured, well-defined, globular, dense corpuscles, one of these bodies occupying the centre of the transverse pale space.

Length of joint varying from $\frac{1}{200}$ to $\frac{1}{50}$ of an inch (averaging about $\frac{1}{100}$ in.); diameter of joint $\frac{1}{1900}$ in.

It affords me much gratification to have it in my power to connect the name of my friend Dr. Kinahan with this species, while I feel it a privilege to be permitted to employ this slight tribute of regard, and very unworthy recognition, on my part, of many marks of consideration.

2.—*Leptocystinema asperum* = *Docidium asperum* (*Bréb.*).

Filaments fragile; joints "slender, cylindrical, rough with minute scattered granules;" "ends dilated;" endochrome disposed in an irregularly narrowed, somewhat undulatory, or sub-spiral manner, sometimes bifid at the extremities, (or "scattered"?), and having immersed in it a single median series of globular corpuscles, and usually with a pale space at the centre.

Length of joint, $\frac{1}{97}$ to $\frac{1}{64}$ of an inch; breadth, $\frac{1}{2356}$; breadth at end, $\frac{1}{2272}$. (These are the measurements given by Ralfs, "British Desmidiæ," p. 159, with which my own have agreed very closely.)

3.—*Leptocystinema Portii* (*nov. sp.*).

Filaments very fragile; joints very slender, fusiform, very gradually tapering to the ends, where they become dilated, giving to the apex a sub-capitate appearance, rough with minute scattered granules; endochrome disposed in an irregularly contracted manner, having immersed in it a single median series of globular corpuscles, and usually with a pale space at the centre.

Length of joint varying from $\frac{1}{200}$ to $\frac{1}{105}$ inch; diameter at the middle of the joint, $\frac{1}{3500}$; just under the dilated extremity, $\frac{1}{5630}$; and of the extremity itself, $\frac{1}{4660}$ in.

Although the compliment may be but an unpretending one, it affords me great pleasure to have the opportunity of associating the name of my friend, George Porte, Esq., with this species,—a gentleman whose manipulative skill in its use is only equalled by his admiration of the many beautiful objects brought to view by the microscope,—while it will be commemorative, too, of the origination and initiation by him of a series of pleasant re-unions, at once scientific and social, on the part of a limited little circle, in the number of whom it is my own esteemed privilege to be counted a unit.

Another form to which I would next direct attention is one in which I find a single, but important, difficulty, in referring to the genus Sphærozosma, and it is the following:—I cannot find either one or two "glandular processes" between the joints of the filament, the presence of which is one of the characters of the genus Sphærozosma (Corda). The filament, which is very minute, is, however, plane and fragile; while the joints, which are about as broad as long, are constricted by a sharp, not deep notch at each side between the projecting lateral inflations at the base of the segments, giving a pinnatifid appearance to the margin of the filament, which thus possesses all the characteristics of Sphærozosma, save the one above noticed. Surrounding this form I do not think there exists a gelatinous sheath; but I am not able to affirm this at all confidently. The ends of the segments are straight and abruptly truncate, each in close apposition to the truncate end of the neighbouring joint, without the apparent intervention of any "glandular processes" (Fig. 7).* This form is very minute, and is very fragile; hence seldom found having more than fifteen or twenty joints in the filament, generally less; often one single cell only is met with. The endochrome is light-green, and possesses a single "vesicle" (or corpuscle) at the centre of each segment. Its minute size, the absence of the conspicuous central solitary "gland," its truncate and square-angled (not rounded) ends, and the lateral pouting projections of each joint at the base of the segments, readily distinguish this form from *Sphærozosma vertebratum.* It differs from *Sphærozosma excavatum*, which it more nearly approaches in size, by its square ends and lateral protuberant inflations, with a sharp notch at the constriction at each side, and in being wider at the basal inflation of the segments than at the ends, not, as in *Sphærozosma excavatum*, with rounded ends wider there than at the centre, and having a deep wide sinus at both sides of the joint. I may add that, so far as my humble experience goes, the "junction-glands" of *Sphærozosma excavatum* are often very obscure. The separated joints of the form of which I have tried to convey a conception, considerably resemble a minute form of Cosmarium, and such I thought a single joint was till I met it in lengthened filaments. To obviate the difficulty here met with, two courses may appear to be open: either to allow this plant to remain as an aberrant member of the genus Sphærozosma—an unadvisable course if it could be avoided—or else to alter the characters of the genus by omitting the "junction-glands" as essential to it, for it appears, I think, that the plane or compressed filament is itself enough to distinguish Sphærozosma from the cylindrical or angular filamentous genera,

* I would here remark that *Sphærozosma pulchrum* (*Bailey*), an American species, is described and figured (Ralfs' "Br. Des.," Appendix, p. 209, Plate XXXV., Fig. 2, *a* and *b*) as having straight junction-margins, connected by short bands, without any mention of "glandular processes." In the drawing the joints are represented in both figures as even without septa between them, giving the idea of a continuous compressed tube, with lateral inflations, but which in this respect is surely erroneous; but which, if drawn, would give a junction-margin somewhat like that described above.

expect, perhaps, *Aptogonum desmidium*, β, which, however, is distinguished by the foramina between the joints. This view I would, then, very submissively put forward. In any case I do not see I have an alternative but to describe this form as a Sphærozosma, as follows:—

Sphærozosma pulchellum (*nov. sp.*).

Filament very minute and fragile; joints (including inflations) about as broad as long; ends truncate, with square angles; segments suddenly inflated at the base, and separated from each other by a shallow acute notch, thus giving to the margin, at each side, a pouting appearance at the central constriction, each segment of the joints containing a single central light-coloured corpuscle.

Length of joint, $\frac{1}{2330}$ in.; diameter of joint at the end, $\frac{1}{4650}$; diameter at widest part of inflation, $\frac{1}{2330}$ in.

I have also to bring to notice a species of Staurastrum, which, though minute, and not very striking in appearance, there can be no doubt is an undescribed one. In the front view this little organism might possibly be taken for a small form of *Arthrodesmus incus* (Figs. 8, 10); but the central constriction is not so deep, nor is the constricted portion so narrow, nor are the segments comparatively so dilated at the ends, nor is the gibbous appearance at the base of the segments often seen in *Arthrodesmus incus* present in the form in question; however, an end view, showing its four, or frequently three angles, dispels all doubt, and at once proclaims the plant a Staurastrum (Figs. 9, 11). It differs from *Staurastrum dejectum* (*Bréb.*) by its much smaller size and less deep constriction, and angles not inflated in the end view; from *Staurastrum cuspidatum* (*Bréb.*), the end view of which the triangular variety most approaches, by its much smaller size, straight sides in end view, and non-inflated angles, and by the want of a connecting band in the front view. It resembles more nearly *Staurastrum minus* (*Kütz.*), an end view of which is figured in Ralfs' monograph, but which has not yet (I believe) been found in Britain; but that species presents five angles, not three or four, as in this species. I do not think I need contrast it with any other species. The angles in the end view of the quadrangular form are right angles, and the sides straight; in the triangular form the end view is equilateral and straight-sided, both forms possessing a single awn or acute spine at each angle. The awns are a little longer in the triangular variety than those of the quadrangular. I was fortunate enough to meet with the sporangium of this species (Fig. 13); it is spherical and acutely spinous, in fact, very like that of *Arthrodesmus incus*. That this form is a sort of connecting link, as it were, between Arthrodesmus and Staurastrum seems probable, from the not remote likeness in the front view to *Arth. incus*, as well as from the similarity of the sporangium in each. I would, therefore, venture to put forward the following to serve as a description of this species:—

Staurastrum O'Mearii (*n. s.*).

Frond very minute; segments smooth, ends truncate (in the quadrangular variety slightly convex); central constriction not deep, forming an obtuse angle; constricted portion very short; a single awn at each angle; awns diverging in the front view, acute.

End view quadrangular or triangular; sides straight;* angles not inflated.

Sporangium orbicular, spinous; spines at first subulate, afterwards slightly inflated at the base, acute.

Length of frond of quadrangular variety, $\frac{1}{1866}$th of an inch; breadth at end (exclusive of spines), $\frac{1}{2500}$; diameter at isthmus, $\frac{1}{3110}$; length of spine, $\frac{1}{5600}$.

Length of frond of triangular variety, $\frac{1}{1750}$th of an inch; breadth at end (exclusive of spines), $\frac{1}{2300}$; diameter at isthmus, $\frac{1}{3500}$; length of spine, $\frac{1}{3400}$.

Diameter of sporangium, without including spines, $\frac{1}{1750}$th of an inch; including spines, $\frac{1}{870}$th of an inch.

It is with very great pleasure I am permitted to call this species after my friend the Rev. Eugene O'Meara, to whom I trust it may afford some gratification to have his name associated with this species of a group kindred to his favourite and beautiful Diatomaceæ.

There remains one other new species which it becomes my duty to bring forward and describe, which, owing to its elongate form, and not being at all constricted, and its entire segments, at once takes its place in the genus Penium.† It is in size about equal to *Penium Brébissonii*, but otherwise not at all resembling that species. Its outline is broadly spindle-shaped or fusiform, tapering pretty quickly to the ends, with cuneate segments, which are bluntly and roundly pointed, and it presents always the same form when made to roll over. The endochrome is granular, and bright green, with a transverse, rather sharply defined, pale band at the centre; and usually has immersed in each half a single central corpuscle. Close to each end there exists a smoothly and sharply defined, perfectly circular cavity, excavated, as it were, out of the endochrome, in which there are two or three active granules, as in Closterium (see Fig. 14). The endochrome sometimes appears as disposed in longitudinal fillets, but more frequently this is not evident. The drawings represent this fully as marked as I have noticed it. The mode of division in this form appears to follow that in Closterium, by a separation of the contents and external constriction. Fig. 15 represents this process half accomplished.

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* I fear the figures (Figs. 9, 11) may convey the idea of the sides being somewhat concave: they are quite straight, and have the angles tipped merely with an awn.

† The description of this species of Penium having been written since this paper was read, and since the former part of it went to press, the "heading" includes only four new species, instead of five; but I have, nevertheless, introduced it, anxious to take advantage of the Plate.

I was not able to see its commencement, but in the specimen from which the drawing has been taken, in about thirty-six hours from the time I saw the stage represented in the figure (Fig. 15), the new halves were completed. As is usual, the new segments maintained a connexion with each other simply by the extremity, until they had nearly fully grown, when they became detached; but I could not see that they were held together, or at all surrounded by any gelatinous investment. Like *Penium Brébissonii* and others, however, it may be that this is sometimes absent, though at other times abundantly evident. I apprehend that the act of division indicates that the individual had attained the full form and size of the species. The straight outline of this form, as, indeed, I need hardly point out, at once excludes it from Closterium, while it is, of course, equally decisively distinguished from Docidium by its tapering form, rounded (not truncate) ends, and by its want of a central constriction and its non-inflated segments;—from Spirotænia (in the recent state at least), its scattered, non-spiral endochrome at once removes it;—the want of a constriction and terminal notch excludes it from Tetmemorus;—while, from all the foregoing circumstances, it will be seen that it is really a Penium. From the striate, or granulate species of Penium, it may at once be known by its smooth frond, from which, indeed, its attenuated ends would sufficiently distinguish it. Of the species with smooth fronds, it appears to have greatest affinity to *Penium closterioides* (*Ralfs*), by reason of its terminal cavities with moving granules, and its fusiform outline. But, in the form in question, its very much smaller dimensions, combined with the entire absence of, or sometimes faintly apparent, longitudinal fillets, as well as the presence of only two conspicuous dense corpuscles (not a longitudinal series), its more cuneate segments, and its more narrow and slender ends, to which the terminal cavities are closer, readily distinguish it from that species. From the other smooth species, except *Penium interruptum* (*Bréb.*), the presence of the terminal cavities, containing active granules, at once removes it, while it never could be mistaken for that species (with which it is, indeed, unnecessary to compare it), on account of its far more minute size, as well as the absence of the two additional transverse bands, and its fusiform (not cylindrical) outline. Neither can it be mistaken for *Cosmarium curtum* (*Ralfs*) = *Penium curtum* (*Bréb.*), from which it is at once separated by its smaller size, less inflated appearance, the want of any central constriction and of so conspicuous longitudinal fillets, as well as by the possession of the terminal cavities, containing moving granules.

There is only one other form with which I need particularly contrast it, and that is *Spirotænia obscura* (*Ralfs*). At first sight it might appear unlikely to be mistaken for that species, nor is there any resemblance when fresh specimens of both are examined. *Then* the spiral arrangement of the endochrome in Spirotænia alone is an abundantly sufficient mark of distinction; but when *Spirotænia obscura* is kept for some time in the house, this spiral disposition of the endochrome is lost, and it becomes uniformly green. Moreover, there not unfrequently occurs in

this state a withdrawal of the endochrome, leaving a little clear space at the ends, of a somewhat triangular outline, as if bounded on two sides by the outer wall, and in which there is sometimes to be seen a detached granule; but I am not able to make out that this moves. But even in this altered state of *S. obscura* (as in Scenedesmus), its oblique mode of division, and consequent unsymmetrical outline, will easily distinguish it from the form under consideration.

Indeed, this form to me appears very distinct from any other described, and though I have contrasted it with others (almost unnecessarily in some cases), a moment's inspection of recent specimens would, I think, on this point convince any observer. I shall, then, describe this species as follows:—

Penium Berginii (*n. s.*)

Frond minute, about three or four times longer than broad, smooth, fusiform; segments cuneate; ends roundly pointed; endochrome irregular, or sometimes with more or less evident longitudinal fillets, also with a transverse pale band, and having close to each end of the frond a conspicuous, well-defined circular cavity, containing moving granules, and each half usually having immersed in the rest of the endochrome a single central spherical corpuscle.

Length of frond, $\frac{1}{420}$ to $\frac{1}{510}$ of an inch; greatest breadth, $\frac{1}{1750}$ of an inch; diameter at the ends, $\frac{1}{4660}$ of an inch.

I feel very happy in being accorded the privilege of naming this species after the well-known microscopist, Thomas F. Bergin, Esq., M.R.I.A., President of the late Microscopical Society of Dublin; while I trust that gentleman may look upon this trifling compliment as a mark of unaffected, but sincere, respect for his numerous scientific attainments, and more especially in regard to microscopy, the active pursuit of which has been interrupted owing to delicate health, at once greatly to be lamented for his own sake, as well as much to be regretted for the cause of science.

I have thus endeavoured to give my own ideas as to the various new forms, or other matters to which I have directed attention. In regard to my new filamentous form there can be no doubt that it is a Desmid, and as I could not satisfactorily to myself refer it to any genus described, I had hence no alternative but to attempt to make a new genus to contain it. Considering the note appended to the record of the occurrence of *Docidium asperum* (*Bréb.*) in my former catalogue, it may appear unjustifiable temerity on the part of an amateur to essay that, which I there expressed a hope that the occasion might arrive when some of our "master-hands" might see it advisable to accomplish. I had not at that time met with *Leptocystinema Kinahani*—the impression then upon my mind had grown into a conviction, so far as my own judgment on the matter was concerned—and so (though unaided by the advice or opinion of any fellow amateur making these organisms a study, but which I had

reason to hope for, and which, had I been so fortunate as to obtain, would have met with a grateful reception), I have thought it my duty to bring forward this communication. I can only hope that those whose experience enables them to form an opinion may agree with me as to the propriety of the genus Leptocystinema,—while I trust I have succeeded in conveying my own views and meaning intelligibly, though I greatly fear that, in my anxiety to be exact, I may have been only tedious, and with a real wish to be succinct as possible, as well as comprehensive, I may, perhaps, occasionally be found to have drawn undue attention to comparatively trivial circumstances—it is to be hoped, however, not at the expense of points of higher significance, or of greater importance.

The following is the Supplemental Catalogue of Desmidiaceæ found near Dublin (for preceding one *vide* "Natural History Review," Proceedings of Societies, vol. iv., p. 36):—

Didymoprium Grevillii (*Kütz.*), rather rare; though (like other filamentous species) when met with, sometimes plentiful.
Leptocystinema Kinahani (*mihi*) (*n. g.*), very rare.
[Hitherto met with but in a single pond on the Shankhill road, about a mile beyond Ballinascorney Bridge.]
,, asperum = Docidium asperum (*Bréb.*), not rare.
,, Portii (*mihi*), not rare.
Sphærozosma vertebratum (*Bréb.*), rare.
,, pulchellum (*mihi*), very rare.
Micrasterias Jenneri (*Ralfs*), rare.
Euastrum cuneatum (*Jenner*), rare.
,, insigne (*Hass.*), not uncommon.
Cosmarium Ralfsii (*Bréb.*), not uncommon.
,, tinctum (*Ralfs*), rare.
Staurastrum O'Mearii (*mihi*), rare.
,, brevispina (*Bréb.*), rare.
,, monticulosum (*Bréb.*), rare.
[Of this rare and pretty species, I have found a quadrangular variety (Plate XI., Fig. 16, exhibits an end view), as well as the triangular form recorded in Ralfs. The former differs from the latter only in possessing an additional side and angle, and in the gatherings in which it occurred the quadrangular variety was rather the more numerous; both are rare, however. I do not think there can be any doubt as to the form of which the end view is figured (Fig. 16), being the *Staurastrum monticulosum* (*Bréb.*), yet as the drawing after M. de Brébisson in Ralfs appeared to me as not quite characteristic, especially as to the end view, at least as far as my plant was concerned, having the opportunity, I have thought it might be worth while to introduce a sketch. The diameter of end view is

$\frac{1}{700}$th of an inch; extreme length of front view, $\frac{1}{500}$th of an inch.]

Staurastrum gracile (*Ralfs*), rare.
,, tetracerum (*Kütz.*), rare.
,, cyrtocerum (*Bréb.*), ,,
,, asperum (*Bréb.*), ,,
,, enorme (*Ralfs*), very rare.
,, spongiosum (*Bréb.*), very rare.
,, aculeatum (*Meneghini*), rare.
,, spinosum (*Bréb.*), common.
,, vestitum (*Ralfs*), rare.
Tetmemorus lævis (*Kütz*), not rare.
Penium interruptum (*Bréb.*), rare.
,, Berginii (*mihi*), very rare.

[Sparingly, in a dyke above the Devil's Glen, between the Waterfall and the high road; also in a pond on the "Piperstown road," rather more than a mile beyond Ballinascorney chapel.]

Closterium Ehrenbergii (*Menegh.*), not uncommon.
,, moniliferum (*Ehr.*), ,,
,, Jenneri (*Ralfs*), rare.
,, intermedium (*Ralfs*), rare.
,, angustatum (*Kütz.*), not uncommon.
,, lineatum (*Ehr.*), not uncommon.
,, setaceum (*Ehr.*), not rare.
,, acutum (*Bréb.*), not rare.
,, juncidum β (*Ralfs*), rare.
Spirotænia obscura (*Ralfs*), rare.
Pediastrum pertusum (*Kütz.*), rare.
Scenedesmus acutus (*Meyen*), not rare.

NOTICE OF THE OCCURRENCE NEAR DUBLIN OF A UNICELLULAR ALGA, BELIEVED TO BE ALLIED TO THAT ALLUDED TO BY M. HOFMEISTER ("ANN. NAT. HIST.," THIRD SERIES, VOL. I., NO. 1, JANUARY, 1858), "ON THE PROPAGATION OF THE DESMIDIÆ AND DIATOMEÆ."

APPENDED to a Catalogue of Desmidiaceæ appears not an inappropriate place to record the occurrence in our district of a unicellular plant, which, but for one reason, I think there might not otherwise be much difficulty in concluding to be the same as that alluded to by M. Hofmeister in the paper to which I have before adverted, and which organism he seems inclined to refer, very doubtfully, to this family. The plant met with here consists of a rather large, perfectly spherical cell, containing abundant and large smoothly defined chlorophyll-granules (which appear often as if containing one within the other, shell within shell, to the number of two or three), a scattered layer of which appears to line the internal wall of the cell, while others are distributed within in scattered rows (sometimes almost as if in broken, interrupted planes) radi-

ating either from the central point of the cell, or, as it appears to me, sometimes as it were from a central axis,—thus often giving, more especially when viewed under low powers, a somewhat stellate appearance to the contents (see Fig. 17). The contents, however, are not unfrequently irregularly scattered. So far, this description appears to apply equally to the Leipsic and Dublin plants. In the plant met with here there usually appears a darkish (under a low power almost black) central mass. This, with the whole of the remainder of the endochrome, can be expelled by fracturing the cell by pressure. This central portion is extruded in a cohering, somewhat stringy mass, but can be afterwards broken into granules. It is sometimes shot out with vigour, leaving the separate chlorophyll-granules behind, and which afterwards, in a continuous stream, make their exit through the ruptured cell-wall. The expelled chlorophyll granules, which at first are large and smoothly defined, by subsequent pressure can be broken up into smaller granules, which, when detached, as in other cases, often set up a "molecular" motion in the surrounding water. I have noticed, too (rarely), a molecular motion of the more minute particles within the uninjured cell.

This organism has occurred not unfrequently in the Desmidian gatherings I have made; but nowhere did I meet with the plant in such numbers, and so isolated from other forms, as in a small pool, close to the Sugarloaf Mountain, on the road to Roundwood. I have specimens still by me collected during last summer, and which, living ever since, have been healthfully preserved. A single specimen is visible to the naked eye, being from $\frac{1}{170}$ to $\frac{1}{200}$ of an inch in diameter. The chief difficulty adverted to in reconciling this with M. Hofmeister's plant is the comparative dimensions, as he says with regard to this—"Some are as much as ·05 millim. in diameter." This is (roughly) about equal to $\frac{1}{500}$ of an inch, the dimensions of my specimens being thus often three times as great. When I first met with individual specimens of this organism, I imagined it might have been the sporangium of some Desmidian (possibly of a Tetmemorus), though, as I afterwards found, too large for that. M. Hofmeister compares his plant to the sporangium of *Xanthidium armatum*, *as if* similar in size, and which it no doubt resembles. But though Mr. Ralfs met with but one specimen of the sporangium of that (with us) rather common species, and does not give the dimensions, yet it is surely not much smaller, according to his figure (comparing it with others of known size, and all equally magnified), than $\frac{1}{200}$ of an inch. However, the conjecture that our plant can be sporangium seems to be dispelled by its undergoing self-division; and, as Hofmeister remarks with regard to his plant, "this renders it in the highest degree probable that they are independent organisms,—Desmidiæ without a central constriction, which may form the commencement of a series of forms terminating in Micrasterias."

M. Hofmeister does not describe the mode of division in his plant. That met with here, when about to divide, appears to be more densely filled with endochrome than in the ordinary condition, and its somewhat radiate appearance is less evident:—the first indication of the approach-

ing occurrence of the process of division is the separation of the endochrome, which becomes, as it were, cut through-and-through abruptly into two exactly hemispherical masses, separated by a straight, sharp, smooth line; a slight elongation of the cell next occurs, which goes on, *pari passu*, with a constriction of the cell-wall immediately over the equatorial line of separation of the endochrome, at which stage the dividing cell becomes of a figure of 8 form. The first I met with undergoing this process I thought might be in a state of partial conjugation; but by a little further observation it became evident that this was a process of division. When a specimen has become so far divided, it has assumed a quasi-Desmidian appearance, as it might possibly be taken for a large Cosmarium; but the separated halves of the endochrome of the original spherical cell soon lose their exactly hemispherical form, grow larger, and become rounded off, having secreted a special cell-membrane, and eventually, as two distinct individual cells, similar to the parent, emerge from its loose old cell-wall by rupturing it (Fig. 17). This escape of the newly formed spheres seems to occur sometimes before the constriction of the old cell becomes entirely cut off. At other times this constriction is perfected, and single cells are thus frequently met with, the old cell-wall surrounding the newly formed cell like a loose tunic.

Supposing that M. Hofmeister's plant follows the mode described, might not the bursting (at the annular groove) of the constricted old cell, before the deepening constriction becomes entirely cut off, account, at least in some measure, for the openings or orifices described by him as met with in the empty coat? I have myself in our plant often found the cast-off coats, which are met with usually collapsed or wrinkled, and sometimes with an orifice like what might be supposed to occur under the conditions indicated. However, M. Hofmeister relates his having occasionally noticed as many as six coats inside each other. In the plant met with by me I have not seen more than one inside another. I am not able to state that in our plant the cell-contents, without division, first contracting, secrete a new cell-membrane still within the original coat,—such a process being, I imagine, the only way to account for the fact of several loose coats concentrically surrounding the same cell. Thus, while it appears as by no means decided that M. Hofmeister's plant and that alluded to as met with here, are identical, yet I think it will be at least evident that they resemble each other very much, and are closely allied.

M. Hofmeister has already compared his plant to a Desmidian. At first sight ours has some resemblance to *Cosmarium Ralfsii;* but, being a perfect sphere, it, of course, wants the constriction and elliptic ends of that species. I hardly think, in our plant, that there is a central suture, though the cast-off coats have a *tendency* to split into two hemispherical portions: they often display, after collapse, a flattened or depressed circular portion (when viewed sideways, almost as if a small segment had been *abruptly* cut off the sphere), possibly representing the somewhat flattened surface of contact with the companion cell, just after the complete shutting off of the two cells or entire formation of the double

wall. We have seen that there is not an interruption of the endochrome until the commencement of the process of division. As to the mode of cell-increase which prevails amongst the Desmidiaceæ, it does appear probable that during the division and formation of the constriction, the original hemispheres may be pushed asunder, by *new* growth, without their materially altering. But, even so, is this an *exclusively* Desmidian (and Diatomacean) characteristic ? An apparently similar mode of division seems to hold good with the greatly more minute cells of the moniliform filaments of the Nostochaceous Algæ (e. g. Dolichospermum). One of these globular cells appears to elongate, to become constricted into a figure of 8 form, deeper and deeper, until two new globular cells grow out of one, during which process the opposite hemispheres of the original cell appear to remain unchanged. So in the plant in question. The main distinction appears to be, as I apprehend, that in neither of these organisms is the first step of the process of division—the formation of a septum between the halves of the cell-contents, as appears to prevail in the Desmidiaceæ. So far as I can make out, the halves of the contents of the cell about to divide (in the plants alluded to) merely become retracted from each other, separated by a sharp, smooth line of demarcation, and eventually become shut off by an addition to, and external gradual constriction of, the original outer cell-wall, as well as, of course, the original primordial utricle, afterwards producing each its own proper cell-membrane. In other words, the new and intervening growth appears to be an extension and continuation of the original outer wall of the dividing cell, —still a single cavity only, until the constriction becomes shut off, or until the halves of the cell-contents have withdrawn and become invested each by its own special coat,—not, as in Desmidiaceæ, according to Hofmeister, the expansion of the "younger inner layer of membrane not firmly adherent to the older portions." But, again, both our Dublin plant and Hofmeister's appear to have some affinity to Glæocapsa. In them, however, there is enclosed, in the loose outer cell-membrane, only one green cell,—not as in Glæocapsa, 2, 4, 8, &c. But there does appear, perhaps, a greater similarity in the separate persistence for some time of the outer cell-wall in each. In Glæocapsa the outer concentric layers, formed by their solution into a confluent gelatinous mass, usually remain in some numbers—in M. Hofmeister's plant he states to the number of six sometimes—the chief difference in this respect apparently being, that they do not, as in Glæocapsa, become gelatinous, but are eventually cast off as loose wrinkled membranes. The green cells sometimes escape from Glæocapsa, too, by a fracture at the side, leaving behind the empty concentric layers.

It is greatly to be hoped that upon a study of his plant M. Hofmeister may decide upon "a local habitation and a name" for it (and along with which, I apprehend, our plant must follow), which, simple in form as it may be, appears a sufficiently puzzling problem. I have, nevertheless, thought it possible that this imperfect notice of the occurrence with us of an organism, at all events closely allied to, if not identical with, that

alluded to by that distinguished author in his most valuable paper, might possibly, to our local observers at least, possess some interest. Others may have met with the same plant, who, while abstaining from making them public, may have carried out further and far more conclusive observations; and if, by drawing attention to this plant, I should be the unworthy means of eliciting their information, I shall have done some good, and my object in coming forward will have been accomplished.

DESCRIPTION OF PLATE XXI.

Fig. 1. Represents a single detached joint of *Leptocystinema Kinahani*, $\frac{1}{50}$ of an inch in length, magnified 330 diameters, showing the broad view of the compressed band of endochrome, with its longitudinal median series of corpuscles, central interruption, and terminal clear spaces and granules.

Fig. 2. A single detached joint of the same, $\frac{1}{75}$ of an inch in length, magnified 330 diameters, showing the narrow or side view of the compressed endochrome, and terminal granules as well as one or two wandering motile granules remote from the end.

Fig. 3. A portion of a filament of the same, the joints in this case $\frac{1}{100}$ of an inch in length, magnified 200 diameters, showing at its upper portion the lateral view, at its middle the oblique or intermediate view, and at the lower end the front view of the endochrome. The green contents of the continuous joints are, however, in the same filament, usually disposed in the same plane. The second and third joints from the top (shorter than the others) illustrate the fact of recent self-division after the manner prevalent in the Desmidiaceæ, as indicated by the (as yet) not fully grown new portions of endochrome and nascent halves, and the consequent still eccentric position of the pale interruption, which in both joints is as yet considerably nearer to the recently formed septum than when in its ultimate regular central situation in the joint. [Of course, it will not be assumed that the joints are always absolutely mathematically straight. Although usually straight, some are occasionally more or less curved, or even bent (the sides being, however, always parallel), and this, no doubt, owing to external circumstances. I have drawn them not more curved than they not unfrequently have presented themselves. *Docidium Ehrenbergii*, for instance, is described as straight; this is its usual state; but specimens sometimes occur bent almost at right angles, and others sometimes with one segment, in place of being of the usual narrow and elongate form, considerably inflated, or almost globose.]

Fig. 4. Exhibits the pressed-out cell-contents of *Leptocystinema Kinahani*, magnified 330 diameters, showing the gradually broken-

up central *corpuscles*, not "vesicles"—bodies similar, in fact, to those in Spirogyra, &c.—some entirely shattered, when they lose their light-coloured appearance; also representing the granules of the extruded cell-contents, as breaking off and setting up their molecular motion in the surrounding water.

Fig. 5. Three joints of a filament of *Leptocystinema asperum* = *Docidium asperum* (*Bréb.*), magnified 330 diameters, showing the contracted mass of endochrome, with its central corpuscles, and in two of them the pale central interruption (which, however, is not always present). I have introduced this drawing because, so far as my experience goes, that in Ralfs' does not show the normal state of the cell-contents, but an irregular, somewhat densely scattered condition (possibly preparatory to decay), and without any pale central interruption, or series of corpuscles, nor is it exhibited as filamentous. In this, as well as *Leptocystinema Kinahani* when kept for a length of time in the house, and evidently decaying, I have found the cell-contents broken-up and scattered, and the characteristic smooth compressed state of the endochrome very considerably altered.

Fig. 6. Three joints of a filament of *Leptocystinema Portii*, magnified 330 diam.

Fig. 7. A portion of a filament of *Sphærozosma pulchellum*, magnified 450 diam.

Fig. 8. Front view of the quadrangular variety of *Staurastrum O'Mearii*, magnified 450 diam.

Fig. 9. End view of the same, magnified 450 diam.

Fig. 10. Front view of the triangular variety of the same (*St. O'Mearii*), magnified 450 diam.

Fig. 11. End view of the same, magnified 450 diam.

Fig. 12. The triangular variety of the same, front view, in a partially advanced state of self-division, magnified 450 diam.

Fig. 13. Sporangium of same, magnified 450 diam.

Fig. 14. *Penium Berginii* (*mihi*), a specimen $\frac{1}{475}$ of an inch in length, magnified 330 diam.

Fig. 15. The same, after division, magnified 330 diam., the new, partially grown segments still remaining apparently attached by their extremities.

Fig. 16. End view of quadrangular variety of *Staurastrum monticulosum* (*Bréb.*), magnified 330 diam.

Fig. 17. Unicellular plant, showing a small specimen, $\frac{1}{200}$ of an inch in diameter, magnified 120 diameters, referred to at page 124, after division and the entire completion of two new spherical cells. One (the upper) is represented as slipping out from the loose original outer coat. See also M. Hofmeister's figures, *l.c.*, Plate I., Figs. 28, 29, which are, I suppose, magnified 300 diam., although this, with regard to the figures referred to, unfortunately, is not stated.

Dr. E. Percival Wright then exhibited a specimen of a Sea-anemone recently obtained by Professor J. Reay Greene on the coast of Cork. It belonged to the genus Bunodes of Gosse, differing, however, from *B. crassicornis* and its allies in the much greater smoothness of the column, in the absence of the crenated margin round the upper edge of the disk, and in several other particulars. Should it, upon further examination, prove to be a distinct species, he would propose for it the name of *B. Greenii*, after its discoverer.

Professor Harvey, in the absence of Mr. John Bain, Curator of the College Botanic Gardens, next exhibited a fine plant of *Sowerbœa juncea*, and at the same time mentioned that the College Gardens were indebted for the successful culture of this and many other rare plants to the skill and attention of Mr. Bain. He also exhibited a specimen of a new Hypocalymna, which he proposed calling, after its discoverer, "Phillipsii;" for description *vide* p. 296, and Plate XXII.

FRIDAY EVENING, MAY 21, 1858.

Professor W. H. Harvey, M. D., F. L. S., Vice-President, in the Chair.

The Minutes of the last Meeting having been read, were approved of, and signed by the Chairman.

The following Resolution was moved by the Rev. Professor Haughton, seconded by Dr. Carte, and carried unanimously:—

"That this Association desire to place on record their sense of the loss they have sustained, in common with other scientific bodies in Dublin, by the unexpected death of the late Professor Harrison,—a loss which this Association feels in particular, in consequence of the interest always manifested by Dr. Harrison in the progress of zoological science in the University, as evinced by his Lectures on Comparative Anatomy and Zoology, and by his constant attendance at the meetings of this Association."

The following paper was then read:—

ILLUSTRATIONS OF THE FOSSIL FLORA OF THE LOWER CARBONIFEROUS BEDS OF GERMANY AND IRELAND, FROM SPECIMENS PRESERVED IN THE MUSEUM OF TRINITY COLLEGE. BY THE REV. SAMUEL HAUGHTON, FELLOW OF TRINITY COLLEGE AND PROFESSOR OF GEOLOGY IN THE UNIVERSITY OF DUBLIN.

(I.)

Plate VIII. represents, on a scale one-half that of nature, a fine specimen of Knorria (named *Sagenaria Veltheimii* (Sternberg), and *Knorria imbricata* (Göppert), by the German palæontologists). It is a cast of the woody axis of this genus, and exhibits well the dichotomous arrangement of its branches, and the imbricated, spirally arranged leaf-scars characteristic of the Lepidodendra, to which it is evidently allied.

Locality: Hayntren, Saxony.

Geol. horizon: Base of the Lower Carboniferous.

(II.)

Plate IX., Figs. 1 and 2.—Side view and cross section of imperfectly preserved stem of plant, showing central coaly axis and longitudinal striations on external surface; natural size. I cannot refer this plant satisfactorily to any known form. It is a cast of the woody axis of some form of Lycopodiaceous or Endogenous plant; but the central tube presents a structure different from that of any recent forms. The character of the external surface of the cast is better seen in Plate XIV., which shows the structure of the base of the leaves.

Locality: Harrylock Bay, county of Wexford.

Geol. horizon: Yellow sandstone, 380 feet below the lowest bed of Carboniferous Limestone.

(III.)

Plate IX., Fig. 3.—Natural size; stem of smaller branch of same plant as last, showing bases of leaves at lower portion of external surface. The peculiarity of this specimen consists in the spiral tube, filled with coaly matter and peroxide of iron, which twines round the stem, as shown in the figure. Professor Phillips, of Oxford, has suggested to me that it may (possibly) be the stem of some kind of twining fern, which has compressed the stem so closely as to penetrate below the external surface. The bases of the spinous leaves are well shown in the figure.

Locality: Harrylock Bay, county of Wexford.

Geol. horizon: Same as last.

(IV.)

Plate XIV.—Casts of the stems (natural size) of the same plants as those figured in Plate IX. Figs. 1 and 2 show the cast of the leaves at their insertion into the stem. Fig. 3 shows the raised coaly bases of the spinous, lanceolate leaves themselves. They exhibit but a rude tendency towards a spiral arrangement, which may be owing to their very imperfect preservation.

The plants figured in Plates IX. and XIV. are too imperfectly preserved to be named, and appear not to have grown in their present position, but to have been drifted from a distance. They occur in a loose, friable, micaceous, white sandstone, and are accompanied by about an inch and half thick of anthracite coal, occasionally passing into an ochraceous powder, in which no vegetable structure is visible.

Locality: Harrylock Bay, county of Wexford.

Geol. horizon: Yellow sandstone, 380 feet below the Carboniferous Limestone.

Professor J. Reay Greene communicated the results of some observations which he had recently made on the genera of British Ophiuridæ. These he proposed on a future occasion to lay fully before the Association.

Professor Harvey read a paper on "Greyia," a new genus, allied to Brexia, from Port Natal.

Professor J. R. Kinahan, M. D., M. R. I. A., then read the following:—

NATURAL HISTORY NOTES IN DEVON AND CORNWALL.

During a hurried visit paid to Cornwall and South Devon, a few interesting facts came under my notice, which I would wish to place on record in the Proceedings of the Association, as bearing on a subject which at present is assuming some importance among naturalists, viz., the distribution of the lower forms of animal life in the British isles. The greater part of the observations were made in company with C. Spence Bate, F. L. S., to whose kindness I am indebted for the identification of most of the amphipodous Crustacea noticed, and most of which were obtained in a dredging excursion in company with him and Dr. Hugh Falconer, the Rev. Mr. Everest, and Dr. Dansey, in the harbour and roads of Plymouth, within the Breakwater, on the 22nd of April last.

The results afforded deserve to be noted, as the ground is similar in its nature to the ground over which most of my Dublin work has been done, and, therefore, allowing of a comparison being drawn between these two localities.

The nature of the grounds over which we dredged were as follows:—

1. Muddy black sand: here we obtained *Gebia deltura* (one specimen). *Ophiocoma bellis*, *Comatula rosacea*, and a few other species.

2. Shingle free from mud or sand; from hence the more remarkable species were—*Bernhardus Hyndmanni*, *B. Thompsoni*, *B. lævis*, *B. Cuanensis*, *Bernhardus streblonyx*,—all, however, except the last, much rarer than in similar grounds in Dublin. *Inachus Dorsettensis*, tolerably common; *Hyas coarctatus*, one specimen; *Eurynome aspera*, common; *Pilumnus hirtellus*, common. *Portunus puber* and *P. depurator*, common. *P. holsatus*, one specimen. *Porcellana platycheles*, one specimen. *P. longicornis*, very common. *Galathea Andrewsii*, common, but rarer than in Dublin.

3. A Zostera bank, called by the boatmen the "Leek Bank." Here, in addition to *B. streblonyx*, *Port. depurator* and *puber*, single specimens of *Galathea squamifera*, *Crangon vulgaris*, and *Hippolyte* (*Lysippe*) *Cranchii*, occurred; and the only Isopod met during the day, *Idotea pelagica*. We took but one cast of the dredge here.

4. Ridges of slate, which were perpetually bringing up the dredge, required a long and strong pull to free it. Among these, in addition to Echinidæ, we met an old bone containing, safely ensconced within it, a female *Portunus arcuatus* in spawn. It was impossible to note the localities of the Amphipoda obtained, further than that they were more numerous than in Dublin Bay.

The following were among the rarities obtained:—*Gammarus pallidus*, *G. obtusatus*, *G. Othonis*, *Lembos Websterii*, *Ampelisca typicus*.

During the course of the day we landed on the Breakwater, and I was much struck by the immense numbers of Allorchestidæ—a family which has never occurred to me in Dublin. *Allorchestes imbricatus* swarmed all along high water-mark.

The following Echinodermata occurred:—

Comatula rosacea.—Common.
Ophiura texturata.—Not so common as in Dublin.
Ophiocoma granulata.—One specimen; a perfect pest in Dublin.
Ophiocoma rosula.—Not so common as in Dublin.
Uraster glacialis.—One small specimen; common in Dublin.
Uraster rubens.—Common.
Cribella oculata.—Three specimens; very common in Dublin.
Asterina gibbosa.—One specimen on Leek Bank; not met in Dublin.
Echinus miliaris.—Two or three specimens.
Echinus sphæra.—One young specimen. We were not dredging on ground where this species generally abounds.
Amphidotus cordatus.—One specimen.

This group, on the whole, was remarkably deficient as regards *number of specimens,* as contrasted with Dublin Bay dredgings.

I spent several days examining the littoral zone which supplied the following:—*Orchestia littorea,* and *O. lævis,* abundant; *Allorchestes Danai,* common; *Talitrus locusta,* not rare; *Ligia oceanica, Porcellio scaber,* and *Philoscia muscorum,* abundant.

There were well-marked differences in the distribution of the aquatic species of this zone, especially at the borders of the Laminarian zone; not merely as contrasted with those which occur in Dublin Bay, but also in the case of those which are found at Valentia Island, the difference in the latter case being probably due to the fact of the influx of the Plym.

Carcinus mænas.—Abundant.
Cancer pagurus.—In great abundance, markedly more so than in Valentia or Dublin.
Pilumnus hirtellus.—The *common crab* of the beach; extremely rare both in Dublin and Valentia.
Porcellana platycheles.—In about equal abundance as at Dublin and Valentia.
Porcellana longicornis.—Rather rare; very common in Dublin and Valentia.
Portunus puber.—Much commoner than in Dublin, and about as common as in Valentia.
Portunus arcuatus, so common as a littoral species in Valentia, not found here as such, while the following, which are common in Dublin, were not met with:—*Palæmon squilla, Hippolyte varians, H. Cranchii. Xantho florida,* also a common littoral species in Valentia, does not occur here, and I was told was nowhere abundant along the coast. Can this be a Lusitanian form?

To one who had never explored these southern shores the extreme littoral zone furnished a most remarkable sight:—Several species of Tunicata regularly festooning the rocks and squirting water over you at every step;—great bunches of a sponge (*Grantia compressa?*) and of

Polyzoa overhanging every nook and cranny, which were lined with a Balanus not found in Dublin, as far as my knowledge goes;—and, to make the scene more striking in every sense, the rock bored on every side by colonies of *Saxicava rugosa,* all contributing their share to the involuntary shower-bath which the adventurous explorer was compelled to undergo in his researches after the treasures of this shore. I regretted that the short time at my disposal precluded my examining more fully the species found here. Idoteas were rare as contrasted with Dublin; there were but few pools suited for them. I met *Dexamine spinosa, Gammarus locusta, Amphitoe littorina,* in abundance.

Accompanied by my host, I took a short trip into Cornwall, as far as Polperro, passing through Millbrook, Craft's Hole, and Looe, on our way.

Many features of the Botany were remarkably striking. The immense profusion of *Asplenium Adiantum nigrum,* which, interspersed with *Lophodium affinis* and *Scolopendrium vulgare,* completely swathe the steep hedge-rows of the district, unlike anything I had ever seen in Ireland, except in the county of Waterford. The profusion of plants, either unknown as indigenous in Ireland, or else extremely rare, such as the lesser Dodder, which purpled the furze near Polperro; the common parsley, which grows abundantly in the town itself; the purple orchis (*O. mascula*), which abounded along the road side; the dog mercury; several species of Galliaceæ, and many other plants which had not as yet flowered,—made me regret I had not more time to examine the quaint old hollow lanes of this interesting county.

Near Polperro, facing the sea, just outside the town, I met *Asplenium lanceolatum* growing in great abundance; its mode of vernation very distinct from that of its ally. *A. Adiantum nigrum, A. Ruta muraria, A. trichomane, A. marinum, L. multiflora, L. Fœnesecii,* and *Ath. Filix fœmina,* were all abundant. Near Millbrook, on the top of a wall, was a large mass of the sinuated form of *Polypodium vulgare,* as strongly marked in its characters as the specimen first described from the Dargle, county of Wicklow.

We had not passed far on our journey before a dead adder on the road reminded us that we were within the range of the Germanic species of Vertebrates, a fact which the numerous mole earths ridging the pastures and corn-fields on every side of us, and the numbers of blackcaps and redstarts singing and flying about, also confirmed. We did not see any snakes or other reptiles, except one viviparous lizard.

The chief object of our trip was for the purpose of examining the collection of the father of Cornish zoology, Dr. Jonathan Couch, F. L. S. He liberally allowed me to examine an unequalled series of drawings of the fishes of the coast, many of which are unique. He also showed us drawings of many rare Crustacea which have passed through his hands, and accompanied us to the house of a most enthusiastic zoological collector, Mr. William Loughrin, on whom I would strongly recommend every zoologist who may visit this locale to call. Through him, in addition to much valuable information, I was enabled to obtain some very rare Crustacea, such as *Portunus longipes,* &c., which have hitherto only

occurred on the south coast. His mode of preparing animals, particularly the skeletons of fishes, I have never seen surpassed, and seldom equalled, and his charges are most moderate.

In the gardens of the inn at Polperro, *Philougria riparia* is not uncommon; *Porcellio scaber*, *Oniscus fossor*, *O. murarius*, and *Philoscia muscorum*, as usual, abundant. I was surprised not to be able to find *Porcellio pruinosus*, so abundant in Kent, although I searched several likely localities.

In returning home we took the Cliff-road, and at Talland Cove spent a few moments examining the supra-littoral zone (the tide being nearly full in). Here, as might be expected, *Ligia oceanica*, *Porcellio scaber*, *Philoscia muscorum*, and *Orchestia littorea*, were abundant; but I was much pleased by also meeting with a Philoscia new to me, and also undescribed in the books. This I have named *Philoscia Couchii* (*vide* "Proceedings, Dub. Nat. Hist. Soc.," vol. i. p. 111, "Nat. Hist. Review," *ante* p. 195), in memorial of one of the pioneers in the study of the zoological geography of England, and of a few pleasant hours spent in his company. The species appeared abundant, and the following description of the spot where it occurred may probably aid others in finding it. Having descended the hill from Polperro, you cross the stream which drains an extensive osier marsh; the road then turns up a narrow ferny lane, into a very heavy hill; instead of turning up this lane, keep straight on from the bridge, and a few yards brings you up at the foot of the cliff. Here, amongst the loose stones and sea-weed carried up by the high tides into the clefts of the slate rocks, in company with the other Oniscoids and many Myriopoda, *Philoscia Couchii* will be seen hiding among the shingle, and easily distinguishable from *P. muscorum*, which also occurs, by its uniform colour.

At Looe, *Philougria riparia* occurred abundantly among sticks along the river side. I looked carefully for *Phil. vivida*, but could not find it.

In and about Plymouth, the following was the distribution of the Oniscoids:—*Philougria riparia*, rare; *Philougria rosea* (added to our lists by C. Spence Bate), abundant in the gardens of that gentleman's house, and also in his cellars. *Philoscia muscorum*, *Porcellio scaber* and variety, *marmoratus*, *Oniscus murarius*, and *O. fossor*, all common. *Ligia oceanica*, very common.

I did not pay much attention to the Mollusca, but the following Helices are tolerably abundant:—*Helix virgata*, *H. fusca*, *H. aspera*, *H. caperata* (Devil's Point). *Helix hortensis* and *H. nemoralis* are by no means rare in the Cornish lanes. Several of the latter sported the white lip which led Forbes from the examination of shell specimens in collections to fall into the error of uniting the two species, but in all the specimens which I obtained the coarse texture of the animal, and the colour and texture of the foot, proves the distinctness of the animals.

Specimens of *H. nemoralis* with white lips, obtained by me in August on the Antrim road, Carrickfergus, confirm this observation. Among the specimens of *H. hortensis* obtained were several of the curious Albino variety, in which the glands of the mantle not se-

creting any colour, translucent bands pass along the whorls of the shells.

An examination of the original specimen of *Pagurus Dilwynii* (Spence Bate), in that gentleman's possession, enables me to point out another distinction between this species and all the British Paguriform Anomoura which I have had an opportunity of examining, viz., the form of the scale at the base of the eye, which in sp. *Bernhardus*, *Thompsoni*, *lævis*, *Prideauxii*, *Cuanensis*, *Hyndmanni*, and *Ulidianus*, is invariably entire along its outer edge, and the scales of opposite side divergent, whilst in *P.* (?) *Dilwynii* these parts are triangular, strongly denticulate along upper outer margin, the inner edges parallel, and closely approximating, exactly as in many species of the genus Paguristes of Dana. It evidently belongs to a distinct genus from the other species of Paguroid Anomoura found on the British coasts.

The following shows the species of Crustacea met with during my visit; it of course gives only an imperfect idea of the Crustacea of the neighbourhood:—

LIST OF SPECIES.

(D., dredged; L., littoral; T., terrestrial.)

Inachus Dorsettensis, D.
Hyas coarctatus, D.
Eurynome aspera, D.
Cancer pagurus, D. and L.
Pilumnus hirtellus, D. and L.
Carcinus mænas, L.
Portunus puber, D. and L.
,, arcuatus, D.
,, depurator, D.
,, holsatus, D.
Bernhardus streblonyx, D. & L.
,, Cuanensis, D.
,, Hyndmanni, D.
,, lævis, D.
,, Thompsonii, D.
Porcellana platycheles, D. & L.
,, longicornis, D. & L.
Galathea squamifera, D.
,, Andrewsii, D.
Gebia deltura, D.
Homarus vulgaris.
Crangon vulgaris, D.
Hippolyte Cranchii, D.
Mysis chamæleon, L.
Talitrus locusta, L.
Orchestia littorea, L.
,, lævis, L.
Allorchestes Danai, L.
,, imbricatus, L.
Montagua monoculoides, D.
Ampelisca typicus, D.
,, Bellianus, D.
Dexamine spinosa, L.
Lembos Websterii, D.
Gammarus locusta, L.
,, Othonis, D.
,, pallidus, D.
,, obtusatus, D.
Amphitoe rubricata, L.
,, littorea, L.
Ligia oceanica, L.
Philoscia muscorum, L. and T.
,, Couchii, L.
Philougria riparia, T.
,, rosea, T.
Oniscus murarius, L and T.
,, fossor, L. and T.
Porcellio scaber, L. and T.
,, ,, var. marmoratus, L. & T.
Armadillium vulgare, T.
Idotea pelagica, D.
,, tricuspidata, L.

Mr. Bain exhibited a specimen of the Water Chestnut (*Trapa natans*); also some plants of *Bossiæa Preissii*, raised from seeds presented by the Archbishop of Dublin, to whom they had been sent from Australia.

Mr. E. Burchall exhibited a collection of foreign Lepidoptera from Demerara.

The Meeting then adjoured to the 21st of June.

FRIDAY EVENING, JUNE 21, 1858.

PROFESSOR W. H. HARVEY, M.D., F.R.S., F.L.S., VICE-PRESIDENT, in the Chair.

THE Minutes of last Meeting having been read, were approved of, and signed by the Chairman.

CONTRIBUTIONS TOWARDS A CATALOGUE OF DIATOMACEÆ OF THE COUNTY OF DUBLIN. (SPECIES OBTAINED AT MALAHIDE AND PORTMARNOCK BY THE REV. EUGENE O'MEARA, A.M.)

Achnanthes longipes, *a*
,, ,, γ.
,, brevipes.
Actinocyclus undulatus.
Amphipleura sigmoidea.
Amphiprora alata.
,, didyma.
Amphitetras antediluviana.
Amphora ovalis.
,, membranacea.
,, affinis.
Bacillaria paradoxa.
Biddulphia aurita.
,, pulchella.
,, rhombus.
,, turgida.
Campylodiscus parvulus.
Cocconeis diaphana.
,, scutellum.
,, ,, β.
Coscinodiscus minor.
,, radiatus.
Diatoma elongatum.
,, grande.
Epithemia constricta.
,, musculus.
,, Westermanni.
Eupodiscus sculptus.
Gonphonema marinum.
Grammatophora marina.
,, serpentina.
Himantidium Soleirolii.
Isthmia nervosa.
Melosira nummuloides.
,, subflexilis.
Navicula ambigua.
,, convexa.
,, didyma.
,, elliptica.
,, elegans.
,, Jennerii.
,, inflata.
,, minutula.
,, ovalis.
Navicula palpebralis.
,, punctulata.
,, rhyncocephalus.
,, Westii.
Nitzchia angularis.
,, bilobata.
,, sigma.
,, spathulata.
Odontidium Harrissonii.
,, mesodon.
Orthosira marina.
Pinnularia cyprina.

Pinnularia distans.
,, peregrina.
Pleurosigma angulatum.
,, æstuarii.
,, balticum.
,, fasciola.
,, hypocampus.
,, quadratum.
,, strigosum.
Podosira hormoides.
,, maculata.
Rhabdonema arcuatum.
,, minutum.
Rhipodophora paradoxa.
Schizonema cruciger.
,, comoides.
Schizonema Smithii.
,, parasiticum.
Stauroneis pulchella.
,, salina.
Surirella fastuosa.
,, gemma.
,, ovata.
,, ovalis.
Synedra arcus.
,, affinis.
,, radians.
,, ulna.
,, Vaucherii.
Tryblionella acuminata.
,, marginata.
,, punctata.

Not described by Smyth.

Amphiprora complexa (*Greg.*)
,, maxima ,,
Amphora quadrata ,,
,, proboscidea ,,
Denticula nana ,,
Epithemia marina (*Donkin*).
Navicula granulata (*Bréb.*)
,, rectangulata (*Greg.*)
,, lyra ,,
Nitzchia virgata (*Roper*).
Pinnularia late-striata (*Greg*).
Pleurosigma Wansbeckii (*Donkin*).

Professor J. Reay Greene, Honorary Secretary, read a paper, of which the following is an abstract:—

ON THE BRITISH SPECIES OF THE GENUS EQUOREA.

In the late Professor E. Forbes's "Monograph of the British Naked-eyed Medusæ" there occurs no mention of any species belonging to the genus Equorea. Since the publication of that work, however, four British species of this genus have been figured and described, viz. :—

1. *Equorea Forskalea* (*Peron*). First ascertained by Professor Forbes to be an inhabitant of the Scottish seas (*vide* "Proc. Zool. Soc.," Nov. 1851).
2. *Equorea vitrina* (*Gosse*).
3. *Equorea Forbesiana* (*Gosse*).

These two species, previously undescribed, were obtained by Mr. Gosse on the coast of North Devon (*vide* "Devonshire Coast," pp. 340–8).

4. *Equorea formosa*, described by the author in his paper on the "Acalephæ of Dublin Coast" (*vide* "Nat. Hist. Rev.," vol. iv., p. 245).

To these may be added a fifth species, first discovered by the author in Dublin Bay, and since found by him on several parts of the south-west coast of Ireland. The umbrella of this Equorea varies in shape, being in some specimens almost discoidal, whilst in others it is campa-

nulate and convex. The sub-umbrella is about half the height of the disk. The central stomach is exceedingly simple in structure, apparently consisting of two regions, from the upper of which issue the gastro-vascular canals, which vary in number from eight to twelve, according to the size and age of the specimens selected for examination. The marginal tentacles are very numerous, and highly contractile, each springing from a pale tawny bulb, at the upper part of which is situated a conspicuous ocellus, of a black, or rather, perhaps, intensely dark violet, colour. To the naked eye these ocelli are invisible, but they serve to impart an exquisite roseate tinge to the margin of the disk. The reproductive glands occur as thickenings in the radiating canals, being usually placed in the neighbourhood of the central peduncle. It is probable that this Equorea is identical with some one of the numerous foreign species of the genus described by Peron, or Quoy and Gaimard; but the descriptions given by these authors, too often scanty and insufficient, together with the impossibility of obtaining access to the plates of Peron and Lesieur, renders this point difficult of determination. This Medusa is gregarious, occurring in considerable numbers in those localities where its presence has hitherto been detected. In size it does not exceed one inch in diameter.

Dr. Carte exhibited a living specimen of the Lepidosiren, obtained by Lieutenant Dun from the River Gambia.

Some conversation then ensued, in which Drs. Carte and Kinahan took part.

Dr. E. Percival Wright read Notes of an Entomological Tour in the West of Ireland in 1857.

The Association then adjourned for the Session.

ROYAL IRISH ACADEMY.

MONDAY, JUNE 14, 1858.

James Henthorn Todd, D. D., President, in the Chair.

Henry J. Brownrigg, Esq., and the Ven. Frederick Goold, Archdeacon of Raphoe, were elected Members of the Academy.

William Drennan, Esq., read the following paper—

ON AN ANCIENT INSCRIPTION SUPPOSED TO BE IN THE ETRUSCAN LANGUAGE.

Donaldson, in his "Varronianus," pp. 126, 127, gives an inscription which he conceives to be Etruscan, in which the Pelasgian element preponderates; and he proceeds, in a note, to offer suggestions for explaining it upon that supposition. In consulting his work for etymological purposes, it struck me very forcibly that the words of this inscription,

with a slight change in the division of the letters, were Hellenic rather than either Pelasgian (which I believe to have been a comparatively barbarous dialect) or Etruscan. I proceeded to read them on that hypothesis, and they certainly seemed to me to afford a very probable and adequate solution of the enigma. I, therefore, requested permission, and obtained it, to mention my conjecture to the Academy, and I was in hopes that it might have excited some interest, both from 'this interesting fragment,' as Donaldson terms it, not having been attempted to be explained up to 1844, the date of the "Varronianus;" and also from the new view, as it seemed to me, which it tended to open up respecting the very great antiquity of the Hellenic or Epic form of the Greek language. For the inscription is on a vase, which was dug out of a tomb at Cervetri, the ancient Cære or Agylla; and the tombs there are supposed by Italian *literati* and architects, according to Mrs. Hamilton Gray, in her "Sepulchres of Ancient Etruria," to be *above* 3000 years old.

They are found to contain articles of such magnificence and taste as induce the belief that centuries must be conceived to have rolled away ere a people could have attained such a height of civilization. Indeed, this view would pretty well settle the claims of the Latin language, or even of most of its elements (contrary to the received opinion of scholars), to be considered as older than the Greek. It is curious that Donaldson appears to labour under a suspicion that some of these inscriptions called Pelasgian or Etruscan are "almost Greek," "nearly akin to Greek," and "little else than archaic Greek," and, yet, that he did not attempt to explain this particular one as Greek.

His explanation, indeed, is merely of the words *singly*, and he says that the interpretation of the whole must be mere guess-work. After such an assertion from a scholar of his reputation, I proceed to offer an interpretation with considerable diffidence, and chiefly in the hope that some member of the Academy, better qualified than I have any pretensions to be, may enter on what may prove a most interesting inquiry. I have not seen a *fac-simile* of this inscription, which, unfortunately, is not mentioned in Mrs. Gray's work; but, judging by the specimens of those which she has given, it must have run without intervals between the letters or words, from right to left.

I propose to read it thus, as Greek, for greater convenience, in the more modern form of letters and direction:—

ΜΙ ΝΙΚΕ ΘΥΜΑ ΜΙ ΜΑΘΥ ΜΑΡΑΜ ΛΙΣΙΑ ΙΘΙ ΠΥΡΕΝΑΙ
ΕΘΕΕΡΛ ΙΣΙΕ ΕΠΑΝΑ ΜΙ ΝΕΘΥ ΝΑΣΤΑV ΗΕΛΕΦV.

Or, as I interpret it, in a more common form:—

Μι Νικη· θυμα μοι, μαθυ, μηρον, λυσει ιθι πορηναι·
Ετερᾳ, εσσι ηπανα, μοι νεθυ, ναστον, αλειφα.

"I am Victory; go provide for me incense, wine, flesh, for expiation.
Or you are needy; for me, water, barley-cake, oil."

I remark on the words singly.

Mi.—I agree with Donaldson, = εσμι, or in old inscriptions εμι = ειμι.

Niké.—I find in an epigram of Simonides that *Nikō* was the name of a woman in his day. It applies particularly happily in this case, as in the same tomb were found the gold ornaments of a *female*, supposed to be a *warrior queen.*

Thuma requires no remark, except that strong perfumes were found in these Etrurian tombs.

Mi.—This *mi*, and those following, I look upon as *moi*, or Lat. *mihi*, contracted *mī*. Donaldson acknowledges a difference of quantity from the first *mi*.

Mathu.—Doric form of μεθυ.

Maram seems doubtful. I have supposed it to mean μηρον, or thigh.

Lisia is conjectural. I supposed it might mean λισσω, *I entreat;* but λυσει, for sacrifice or expiation, seems as probable.

Ithi porenai.—Go provide. Neither ο nor ω occurs in these inscriptions: its place is supplied by υ generally; occasionally by α. The form of *porenai* seems poetic, like φορηναι in Homer for φορειν. It may be read *purenai* for *pureuein*, or *burn;* but a word applicable to all the nouns seems preferable.

Etera (ο-δῳ understood), *otherwise.* The ε possibly of the inscription doubled by mistake.

Isie of the inscription I suppose to be εις, or εσσι, its Doric form.

Epana.—An old form of the word, not now occurring as an adjective; σπανιος and πενης, other forms; but ηπανια occurs, though rare.

Nethu.—An old word for water. It were hard to say how it became obsolete in Greek. It remains in νησσα, νηττα, *a duck* (or water-fowl), and several other words, and Donaldson says is the origin of the water-god Neptunus; in older form *Nethuns.* This root remains in German, *nass* (wet), and Dutch and Flemish *nat* (meaning either water or wet).

Naston.—Barley-cake. Perhaps it might be read in the genitive ναστου, τι or ολιγον understood.

Aleipha is rather an Ionic than a Doric or Epic form; the *h* merely marks a difference of pronunciation. See Thiersch, Gr. Grammar, p. 45, that the rough breathing has been dropped from many Greek words in later times.

To conclude—I do not pretend to defend every word of the above interpretation; it must be remembered that *bad spelling* is not uncommon in such early inscriptions, and allowances made accordingly. It is sufficient for me if on the whole it presents a probable meaning, and if it should furnish the slightest clue to other inscriptions I shall be amply rewarded for any little pains which this one may have cost me.

Donaldson furnished me with the three words,—the first *mi*, *mathu*, and *nethu*. The lines seem to be *verse;* but I have not attempted here to scan them. I would give Donaldson's explanation, if it did not require to be explained.

Mr. Wilde made the following communication—

ON THE ANCIENT AND MODERN RACES OF OXEN IN IRELAND.

I feel quite certain that any subject connected, no matter how remotely, with the great cattle interest of Ireland—a question always of the highest social concern, and never more so than at the present moment—will be listened to with patience by an assembly so constituted as the Royal Irish Academy. Neither the geologist nor palæontologist have sufficiently explored the earth's surface in this country to enable me to state, from any printed documents to which I have had access, the amount, nature, and distribution of the ancient Fauna of Ireland; but although the book of nature has not been investigated to the extent to which, no doubt, it is capable, our historic records—decidedly the oldest and, I think I may add, the most authentic in any living language in Europe—afford ample materials for drawing up some account of the ancient animals of this country. It has been stated by Professor Owen, chiefly upon the authority of the Earl of Enniskillen, that the remains of bovine animals have been found in the sub-turbary shell-marl in various localities in Ireland, and there is a belief current among naturalists that such remains have been found associated with those of *Cervus megaceros Hibernicus*—our great fossil elk.

It is quite possible that the remains of oxen have been found in clay formations and fresh-water drifts in Ireland; but I have been so long accustomed, in investigating another branch of science, to receive with caution the accounts of collectors, that I should like to have something more explicit and topographical written upon the subject than that of—"various localities." There is, however, every reason to believe that the ox existed contemporaneously with the first inhabitation of the country, and from thence to the present day it has largely contributed to the wealth of this kindom. In the very earliest times man must have been to a large extent a flesh and a fish-eating animal; and in Ireland the primitive inhabitants not only fed upon the flesh of oxen, but were clothed in their skins, formed weapons (pins and fasteners) out of their bones, used their sinews and intestines for strings, and employed different parts of these animals in ministering to clothing and decorative arts. And now, after a lapse of two thousand years at least, we find the Irishman, notwithstanding the fearful losses of the famine period—one of the most direful calamities that ever befell a people—still able to elevate his country in the social scale, to increase his own personal wealth, and to assist in supporting the sister kingdom—by his cattle.

From the earliest period to which our Annals refer we find notices of horned cattle. Thus, we read in the Book of Lecan, that in the reign of Findoll, long anterior to the Christian era, every calf born at a particular period had a white spot on its forehead. A multitude of places are called after cattle—such as Inis Bofin, the island of the white cow; Lough Bofin, the lake of the white cow; Drum-shanbo, the ridge of

the old cow; Dun-bo, the fort of the cow; Agha-bo, the cow-field or plain; Bally-bo, cow-town; Daimh-inis, Ox Island, now Devenish, in Lough Erne; Bo-dhun, or Bawn, a cow fortress or enclosure; Dun-na-mbo, a great cattle fort of stone, in Erris; Cluain-da-damh, the pasturage of the two oxen, in the county of Galway. Other places are called after calves, and some after bulls—as Cluan-dá-tarbh, the enclosure of the two bulls, now Clontarf, near the city of Dublin; and Eden-na-Tarve, in the county of Down. The glen of the heifer, Glen-Samhaisce, in Dalaradia, is one of the oldest local names in Ireland. Legends without number upon the subject of "cow lore," as we might call it, float among the peasantry in every part of Ireland; and stories relating to horned cattle, bulls, cows, and calves, are intimately interwoven with Irish fairy mythology, and become interesting to the archæologist from their topographical references. Many of our popular superstitions, and much of our folk-lore, more particularly concerning the merry month of May, abound in reference to cows and oxen. Cattle raids and forays afforded fruitful themes for the early metrical romance writers and compilers of what is termed Ossianic poetry, the most remarkable production of which is the Táin bó Cuailgne, or great cattle raid of Louth—the "Niebelungen Lied" of Irish history. From all these sources I might cull numerous anecdotes to amuse, if such were the object of this communication. Even the celebrated abduction of Dervorgil partakes, when we come to examine it by the light of modern investigation, more of the nature of a black-mail foray, for abducting cows and bullocks from the plains of Brefny and the slopes of Shemore, than a romance or love passage between an Irish chieftainess, aged 44, and Dermot Mac Murrough, then in his sixty-second year, and, if we can rely upon contemporaneous historians, not remarkable for his amiability of character. Cattle formed not only, in early times, the chief wealth and produce of the country, but were also employed as a means of barter. Thus we read of ransoms being paid with oxen, and as many as 140 milch cows being given for a manuscript. Quantities of the butter and cheese of remote periods have been dug out of our bogs (upon which subject I have already made a communication to the Academy), and many specimens of bog-butter may now be seen in our Museum. In the Leabhar na g-Ceart, or "Book of the Rights and Privileges of the Kings of Erin," cattle are frequently mentioned as being derived from those localities, such, for example, as Rathcroghan and Moylurg in Roscommon, parts of Limerick and Tipperary, the plains of Meath and Westmeath, &c., &c., which are to this day celebrated for producing the best stock in Ireland. As an example of the amount of cattle existing in Ireland in the fifth century, I may cite the following among the tributes paid to the King of Cashel alone, from distinct and separate localities, most of which can be identified at the present day:—"Cows at the time of calving; cows that enrich the farmer's dairy; cows frisking and skipping; cows not like those of ravens, lean or dying; brown oxen; strong oxen; oxen to supply the ploughing," &c., amounting in all to about nine thousand head of cattle. From our collected "Annals" by the Four Masters,

we may learn what was the abundance of cattle at all periods in Ireland, from the numbers said to have been carried off by the chieftains or petty kings in their unceasing wars upon each other, as well as by the destruction of our herds and flocks by invading armies. That oxen ranged wild in some part of the country in very early times, I have long since shown, from the curious zoological poem concerning Cailte Mac Ronan, the foster-brother of Fin M'Coul, who, being required by King Cormack to ransom that chieftain, by producing upon the green of Tara a pair of each animal in Ireland, brought two wild oxen from the district of Burren, in Clare. But at a very early period the Irish domesticated their oxen, and yoked them in the plough.

"In our Brehon Laws, H. 2, 15, p. 40, col. *b*," writes Dr. O'Donovan to me, "the measurement of a cow is given:" in girth "ᵹᵹ ᴅoɼn—twenty hands, or 6 feet 8 inches; from which it would appear to me that the size was smaller than that of our present cow. You will find from the fragments of those Laws, given in Vallancey's Collectanea, vol. iii., that the milch cow was valued at twenty-four screpalls; a three-year old heifer, twelve screpalls; a *calpach*, or two-year old, six or eight screpalls; a *dart*, four *screpalls;* a *dartaid*, two *screpalls*."

Our annals and histories also abound with records of epizootics from a period anterior to the Christian era, down to the recent great pestilence of pleuro-pneumonia which ravaged the flocks of this country, in common with those of the rest of Europe. Their history is exceedingly interesting, as constituting symptoms of those great epidemic constitutions which come upon particular parts at almost regular periods, but which only attract attention when they occur in our own times. As, however, I have recently published an extended history of these epizootics in a Parliamentary Report ("The Census of Ireland for 1851," Part v., vol. i.), I need not do more than allude to the subject here.

The relics of our ancient oxen are not only abundant and interesting to the naturalist, but are exceedingly curious in an historical point of view, as they afford undeniable evidence that, so far back as the eighth or tenth century at the latest, we had in Ireland a breed of cattle which, for beauty of head and shortness of horn, might vie with some of the best modern improved races, so much admired by stockmasters, and which are now being re-introduced from England. I here beg to observe that this communication is not intended as a purely zoological or anatomical paper. I am not going to discuss the mooted question of species and variety; and I am well aware of the great difficulties attending the classification of domestic animals, which have not only been derived accidentally from two or three varieties, but among which great and successful efforts have been made by man to alter their physical characters for his own purposes by what is called breeding—a subject of very great importance in the present day. But breeders and cattle-fanciers, as well as naturalists, have adopted a particular nomenclature, well adapted for expressing their meaning; when, therefore, in the following description I speak of breeds or races of cattle, I am not to be understood as meaning anything more than the varieties of a variety.

According to the most authentic authorities, Cuvier, Herman von Meyer, and Owen, four great types of oxen existed in Europe in early times—first, the *Bos priscus*, or Urus, the great Auroch which the Roman armies found in the primeval forests of Germany and Belgium, and of which a few specimens still remain in the imperial preserves of Lithuania—the chief modern representative of which is the bison. It was a creature with long horns rising above the head, a narrow forehead, high frontal crest, projecting orbits, and a warm shaggy coat. The stuffed specimens I have examined in the museums of Vienna and Frankfort were of a reddish brown-colour, and of great size. The second is the *Bos primigenus* of Boganus, which was also found by the Romans among the fastnesses and entangled forests of uncultivated Europe—with long slightly curved horns, set on at right angles with the head, but turning forwards at the extremities, and spreading to a breadth of nearly five feet from tip to tip; and of which beast it is conjectured the present race of horned cattle in Europe spring. Some degenerate descendants still exist in Sicily; but the Cape buffalo affords the best specimens of the long-horned species. A third extinct ox, described and named *Bos trochocerus* by Meyer, had a very narrow head, and long cylindrical horn-cores rising high above the level of the back of the occiput, and then curving forwards and inwards. All these three have been found in diluvial deposits—the last, however, only in Germany. The fourth, which is almost peculiar to Ireland, has been denominated *Bos longifrons* (the long-fronted or small fossil ox), somewhat of a misnomer, it must be confessed, because, properly speaking, it should be denominated *Bos latifrons*, from the exceeding breadth of forehead and face, in which particular it differs in an especial manner from either of the three former. It is the type of the present short-horn, and the first specimen recorded came from this country long before the present century. "A frontlet and horn-core of this species," says Professor Owen, in his beautiful work upon British Fossil Mammals and Birds, "formed part of the original collection of John Hunter, in the manuscript catalogue of which collection it was recorded as having been obtained from a bog in Ireland." I had entered it in the catalogue of the Museum of the College of Surgeons in 1830, under the name of *Bos brachyceros*, on account of its peculiarly short horns; and, after the imposition of that name upon a living African species, to *Bos longifrons*, under which the remains of this interesting species or variety were described in my "Report on British Fossil Mammalia." In 1839 Dr. Ball, our late Treasurer, brought the subject of the remains of oxen found in bogs in Ireland before the Academy; but the few lines which I find upon the subject in the "Proceedings" have in no wise elucidated the matter or assisted my researches. The animal he described was evidently the small fossil ox of Hunter. He also in 1844 noticed the circumstance in the third volume of the "Transactions of the Geological Society of Dublin," but does not say where or how the specimens were found.

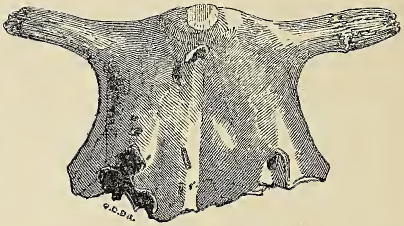
It will be in the recollection of some of the senior members of the

Academy that in the year 1840 I presented to the Museum, and described in the "Proceedings," a large quantity of animal remains which had been discovered in the great crannoge of Lagore, near Dunshaughlin, county of Meath—the first of those curious marsh or lake-fortresses which have been discovered during the last twenty years. The most remarkable, as well as the most numerous, specimens amongst that vast collection, amounting to hundreds of cart-loads, were the remains of horned cattle. With these were found the largest, the most varied, and I think I am justified in saying, the most valuable, collection of antiquities, viewed from an ethnological point of view, which has ever been found in Ireland, of which a large number now adorn our Museum, and serve to fix the range of date of that crannoge and its osseous contents, viz., from A. D. 848 to 933. Since then many other crannoges have been brought to light during the progress of the arterial drainage in different parts of the country, as set forth in the "Catalogue of the Antiquities of Vegetable Material." From these localities, as well as in deep cuttings also made for the same purpose, and in peat bogs, particularly in the counties of Roscommon, Westmeath, Tyrone, Longford, and Fermanagh; from Loughgur, in the county of Limerick; and in the artificial embankments, as well as in some of the subterranean passages of ancient raths—other specimens of bovine remains have been deposited in the Museum by the Board of Works, and by private donors. Several of the specimens which I described in 1840 were subsequently figured in Mr. and Mrs. Hall's beautiful work on Ireland. I have selected twenty heads of ancient oxen belonging to the Academy's and my own collections, and arranged them in four rows, each row characteristic of a peculiar race or breed, viz., the straight-horned, the curved or middle-horned, the short-horned, and the hornless, or maol, all of which existed in Ireland in the early period to which I have already alluded. Can we now identify any of those old heads with those belonging to our native races of the present century? Before that question is discussed it is necessary to say something on the subject of the native cattle of Ireland, ere they became replaced or altered by the old Ayrshires or Durhams, or the more recent improved breeds introduced by Bakewell, Colling, and others.

According to my own observations, we possessed four native breeds about twenty-five years ago. First, the old Irish cow, of small stature, long in the back, and with moderate-sized, wide-spreading, slightly elevated, and projecting horns: they could scarcely be called long-horned, and they certainly were not short-horned. This breed was of all colours, but principally black and red. They were famous milkers, easily fed, extraordinarily gentle, requiring little care, and were, in truth, the poor man's cow,—the "ould Irish stock," the true *Drimin dhu Dheelish;* but they did not easily fatten, and when beyond a certain age seldom put up flesh. They abounded in all parts of the plain country. Second, the Kerry, which is somewhat more of a middle horn. In its native state it is usually much smaller than the former; in colour it is either red,

brindled, or black; it is exceedingly hardy; its milk is abundant and rich, and it possesses the additional advantage of rapidly fattening upon very moderate fare when brought from its native mountains into the plains and fertile country. This race have small heads, and rather short horns, turning upwards. They are very docile, although Fynes Moryson, writing in the times of Elizabeth, and Thomas Dineley, in those of Charles II., describe them as exceedingly ungentle, and "as wicked and rebellious as the people." Several possess many of the finest points belonging to the modern short-horns, and are in some respects superior as a stock, owing to their fattening as well as their milking qualities. Their beef is also most excellent. As was recently stated by his Excellency Lord Eglinton, "they are the thoroughbreds of cattle." Their chief localities are at present the mountains of Kerry and Cork; but it is more than probable that in former times the race existed in all the regions of Ireland. It was said that during hard winters the people of Kerry thatched their cattle by means of mats tied on their backs. Droves of small Kerries are driven by jobbers over the whole country every year, and may sometimes be seen perambulating the streets of Dublin. Third, the Irish long-horns, similar to, but not identical with, the Lancashire and Craven; for while many of the race had wide-spreading horns, only slightly curved, the great majority of the Irish turned so completely inwards that they either crossed in front of or behind the mouth, or pressed so much inwards towards the cheek as to become a source of great irritation to the animal, and to require amputation. They were generally a red or brindled colour; had large bones, grew to a great size, particularly as bullocks, and their drooping horns, sloping gracefully under the chin, gave them a particularly calm expression of face. They were covered with a plentiful supply of hair, which protected them from the inclemency of the weather. This, together with the peculiarity of their constitutions, rendered them an exceedingly hardy race of cattle, never requiring winter fodder, except when the ground was covered with snow. They were not much used as milkers, but were the principal cattle sent to the Dublin market or exported to England thirty years ago. Their hides were of great value, being, when tanned, at least half an inch thick, and I have reason to believe that it was these hides which gained for the Irish leather so much celebrity both at home and abroad in former times. This breed principally abounded on the plains of Roscommon, and might justly be termed the Connaught ox. Fortunes were made in former times, chiefly out of these cattle, which would scarcely be credited at the present day. They grew, as I already stated, to a great size; but they took four or five years to come to perfection. Compared with some of the short-horned races, they possessed, I might almost say, an immunity from disease; they were very docile, and made good ploughers and cart oxen. I have heard it stated that this breed was imported from England about seventy years ago; but among the great collection of bones found at Dunshaughlin I discovered specimens of this race, although smaller than my old com-

panions in the west, thus proving that they existed here in what may be termed our middle ages. The skull and horn-core of one of those which I figured in Hall's "Ireland" many years ago is here represented. There is also a portion of the frontal bone and horn-core of this long-horned breed, found in a bog in the county of Limerick, now in the Museum of Trinity College. Were one to strip the skull of one of these animals of its horn-cores, it would, from the narrow forehead and projecting crest, resemble in a most remarkable manner the cranium of the maol, or hornless breed.



I regret to say that the race is nearly extinct; the only possessor of any that I now know is Lord De Freyne, who has still a stock at Frenchpark, and lately exhibited a pair at the Royal Dublin Society's Cattle Show. They have been replaced upon the plains of Rathcroghan and Moylurg by the modern imported and much prized short-horn—a beast with a thin silky skin, short fine hair, and which comes to perfection, and consequently gives a return to the breeder or feeder, in one-half the time in which the old long-horns did. But it cannot be denied that it is of a comparatively delicate constitution, and must, from the physical circumstances which I have mentioned, be more liable to disease than its hardy, slow-growing, thick-skinned, easily fed predecessor.

I know it will be considered a heresy, and probably presumptuous of me, to offer any opinion upon this subject; but I would propound this question to the grazier, and also to the political economist:—Taking the slow growth, but great size, strong hide, little care required with, and comparative immunity from disease of this long-horned stock on the one side; and, upon the other, the great original first cost, the rapid growth to saleable perfection, and also the quick, but perhaps unwholesome, and certainly unnaturally induced powers of reproduction, together with the great susceptibility of fattening, the thin hide, the winter care, both of housing and provender it required, and the very great susceptibility of disease, both sporadic and epidemic,—and then strike the balance, and I am not sure that it would not turn in favour of our native stock. Certain I am that the beef would be more wholesome. Fashion, however, may have had its influence in this matter. But we need not wonder at £250 being given for a yearling calf, when twenty guineas was but very lately considered a moderate price for a Cochin cock during the epidemic of the 'fowl fever,' which raged so extensively in Great Britain and Ireland.

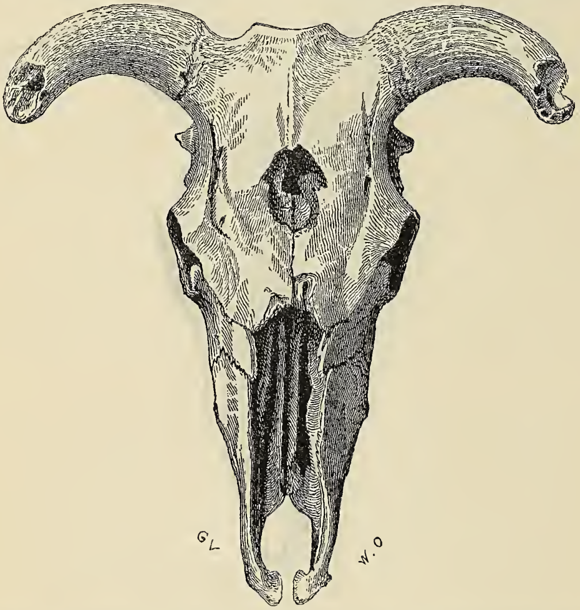
The fourth is the Maol or Moyle, the polled, or hornless breed, similar to the Angus of the neighbouring kingdom, called Myleen in Connaught, Mael in Munster, and Mwool in Ulster. In size they were

inferior to the foregoing, although larger than the Kerry, or even the old crooked horned Irish, but were comparatively few in number. In colour they were either dun, black, or white, but very rarely mottled. They were not bad milkers, were remarkably docile, and were consequently much used for draught and ploughing. Of the four examples of the crania of neat cattle which I have now placed before you, the most beautiful is the straight-horned,—broad in the face, flat on the forehead, nearly level between the horns, with but slight projecting orbits, short, thick slugs or horn-cores, rising but little above the occipital crest, and turning slightly inwards like some of the best short-horned bulls of

the present day. It is eighteen inches long in the face, and nineteen from tip to tip of horn-core. This was found at Dunshaughlin, and is evidently a domesticated descendant of the ancient wild *Bos longifrons*. It is a cranium of surpassing beauty, and resembles in the most remarkable manner the ox-heads carved upon the friezes of Grecian temples,—somewhat conical in the face, with short, straight horns, very broad at the base, and not more than eight or ten inches long, having force, dignity, and mildness expressed in even the dead bone. Were we to wreathe this head with a garland of flowers, we would have before us a perfect example of those taurine embellishments sculptured upon the metopes of the Parthenon during the best days of Athenian architecture. This animal would appear to have been the creature used in sacrifice by the early Greeks, and also by the Hebrews,

and other sacrificing nations. We have no specimen of this native race now existing in Ireland. The four other heads placed beside it are evidently those of cows of the same breed, but slightly differing one from another, probably as the result of domestication. Most of the heads found in crannoges have been broken in the centre of the forehead by some blunt instrument, and a few were evidently perforated by bronze celts, such as those now in the Museum.

The second breed (for I fear calling it a variety, lest I might offend the naturalists) would appear to be the most numerous, and is the curved horned. This magnificent head of a bull of this race (in second row)

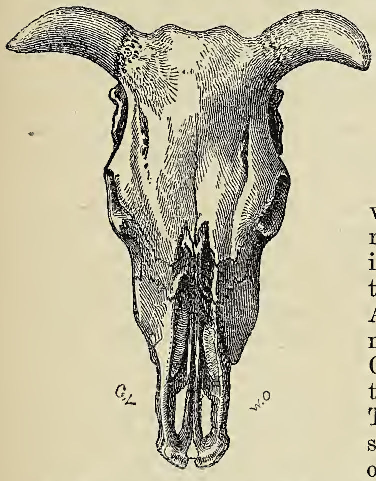


is, in point of size, one of the finest specimens of ancient oxen found in the British Isles: it is 23½ inches long and 8 inches across the forehead, which has been broken in by some blunt instrument, probably in slaughtering. The horn-cores are not so large at the base, but more than twice as long as those of the straight-horned race; they are curved considerably inwards, so that the tips of the horns, when perfect, must have approached much nearer than their bases; each horn-core was, when perfect, about eleven inches long, measured upon its upper curvature. This head, together with most of the others of its class, came from Loughgur, county of Limerick. The horns did not spread so wide or rise so high as those of the modern Kerry.

The third set of heads here arranged were undeniably short-horns, and of a very peculiar class: they are characterized by long, narrow

faces, and exceedingly small short-horn cores, curving abruptly inwards, somewhat like the Alderneys of the present day. I have not found a head of what might be considered a bull of this race, but one of the best of the cow's heads presents the following measurement:—Seventeen inches in length of face, six across the forehead, and eleven from tip to tip of horn-core. This beautiful race was abundant in former times; but I am not aware of its having had a representative in Ireland for the last hundred years at least. An intermixture of this race with the broad-faced straight-horned would give, in my opinion, a breed with which even the most fastidious of our cattle-fanciers could not find fault.

These two cuts afford good illustrations of this race:—



The last is the Maol, or hornless, which differs so little from its living representative of the present day that it is unnecessary to describe it. From the five specimens placed before the Academy, it is evident that it was much smaller than the modern breed. One head differs from another only in the amount of the occipital projection. The average length of the face is about seventeen inches, and eight across the orbits.

As the nomenclature of the naturalist will not assist me in the classification of those different breeds, I must call them by their Irish terms of *Dron-adharcach*, the straight-horned; *Crom-adharcach*, the stooped or curved horned (hence the words 'crommie' and 'crumpled horn' applied to those cattle both in England and Ireland); *Gearr-adharcach*, the short-horned; and *Maol*, the hornless. Thus far, you see, I have only been able to identify two of our ancient stock in modern times with the ancient remains. But now comes the question with which I set out,—From whence came the original short-horns; were they indigenous in England, or introduced prior to the days of Colling, and other great breeders of that class? That they existed in Holland, in great numbers, long before they became fashionable in England, can be proved from Dutch pictures antecedent to the days of Cuyp or Paul Potter. But, centuries prior to the date of these Flemish paintings or English cattle-breeders, we possessed in Ireland quantities of these much coveted and highly prized breeds of long and short-horned cattle, while no other country in Europe has published any account of such animals existing in times contemporaneous

with those I have described. It is true that some specimens of the *Bos longifrons* have been discovered in fresh-water drifts in England; and Owen conjectures that it was the domesticated species in the British Isles anterior to the Roman invasion. But, acknowledging this, it still leaves Ireland the principal habitat of that race, and, so far as our investigations have as yet gone, the sole habitat of the ancient short-horns.

Let me add the following useful observations of my friend Mr. Barnes, of Moynalty, to whom the Royal Agricultural Improvement Society of Ireland awarded a medal for his essay on the best breeds of horned cattle adapted to this country:—"For feeding on a large scale in our rich low pastures, the best breed for Ireland is the short-horned and the cross from the short-horned; where food is abundant, and care and attention can be bestowed, they are suited to the small as well as the large farmer. . . . . . For hilly countries and inclement climates there is no breed of cattle comparable to the West Highland; and where that breed was established I would recommend, where practicable, that it should be crossed with the short-horn; but not with the intention that in such situations the West Highland should be increased by this cross breed: the produce of the cross should be sent forward to the rich pastures to feed. In the other hilly districts, where our native breeds are general, the West Highland bull should be introduced to improve them. By following this system we would establish breeds of cattle in Ireland suited to all situations in the island,—breeds which the most convincing trials have proved must answer all our purposes, and never can disappoint our expectations. The West Highlands are now being introduced into Connemara."

It is greatly to be regretted that the Royal Dublin Society does not possess a perfect collection of the heads of neat cattle, either as stuffed specimens or simple osteological examples, from which amateurs might learn how to distinguish those breeds which are annually exhibited at their great and yearly improving agricultural Cattle Shows,—the best evidence of the increasing prosperity of the country, even though it be a return in a large extent to its original, and, as I believe, its normal condition—that of a great grazing and cattle-feeding country, to which both its soil and climate so amply conduce. I have often spoken to members of the Dublin Society on this subject, and I feel that this allusion to it now will be received in the kindly spirit in which it is intended by those who have the management of the new Museum, and by the able Director, my friend Dr. Carte.

In a strictly antiquarian sense, the propriety of retaining in our Museum unmanufactured animal remains might be questioned; but, regarding the Academy's collection in an ethnological point of view, it has been considered advisable to keep some of these zoological specimens as illustrations of the associations by which man was connected or surrounded in early times, the more particularly as most of them have been found along with some remains of the former inhabitants of this country. Should, however, the Academy think well of presenting the Royal Dublin

Society with a portion of its collection, I shall be happy to increase that donation with specimens from my own collection.

In conclusion, allow me to read an extract from a letter written by Dr. Johnson, in the year 1777, to our distinguished countryman, Charles O'Conor, of Belanagare:—"If you could give a history, though imperfect, of the Irish nation from the introduction of Christianity to the date of the invasion from England, you would amplify knowledge with new views and new objects. Set about it, therefore, if you can; do what you can easily do without anxious exactness. Lay the foundation, and leave the superstructure to posterity." If I have in the foregoing communication elicited inquiry, or laid a foundation for others to build upon, I shall have accomplished the task which I proposed to myself, and, I hope, interested a meeting composed of gentlemen who have always evinced an anxious desire to forward the best objects of Ireland.

Denis Crofton, Esq., read a paper on a Collation of the MS. of the Bhagavad Gîtâ, in the Library of Trinity College, Dublin.

Dr. Apjohn read a communication from Lieutenant Renny, R.E., on the Constants of Barometric Formula.

Rev. J. H. Jellett made some remarks on Mr. Renny's paper.

W. R. Wilde, Esq., presented a bronze celt, on the part of Dr. O'Meara, of Carlow; and also, from William Smith O'Brien, Esq., a wooden stake and part of a cow's horn found under a great depth of bog on the summit of a mountain near Cahirmoyle. The stake was supposed by Mr. O'Brien, as explained in his note, to have formed a "portion of an ancient fence, which has been covered for many centuries with bog. Eleven or twelve feet of turf have been cut from the mass of bog under which it was found. Mr. O'Brien conceives that it is an interesting relic, as it proves clearly that at a very distant period of time the inhabitants of this country possessed sharp-edged tools, which were capable of clearing timber as perfectly as it could now be cut by the best modern hatchet. It also proves that land which at present is of no value except for turf was formerly used for pasturage, and enclosed for that purpose, though it lies in the vicinity of some of the richest land in Ireland. From this circumstance Mr. O'Brien infers that in these early times the county of Limerick was highly peopled; since, if the population were scanty, they would not have taken the trouble to enclose land which, from its position, never could have been of good quality. Mr. O'Brien also at the same time placed at the disposal of the Academy a horn which was found in the same locality, under the same layer of turf. Mr. O'Brien possesses other specimens of these stakes, and he has been told that cart-loads have, at different times, been found by the peasantry when cutting the turf in the same locality."

The thanks of the Academy were voted to the respective donors.

The Academy then adjourned.

MONDAY, JUNE 28, 1858.

James Henthorn Todd, D. D., President, in the Chair.

Dr. Lyons, on the part of the Commission appointed by the Council on March 1st, presented and made some remarks on—

THE REPORT ON THE CASE OF M. GROUX.

The case of M. Groux, on which we have been instructed to report by the President and Council of the Royal Irish Academy, is an example of bifid sternum, or congenital fissure of that bone, a condition noticed by Meckel, Breschet, Serres, and Geoffrey St. Hilaire. By the two last investigators it has been specially instanced in support of the doctrine of osseous development being conducted in conformity with the laws of "bilateral symmetry," and central conjunction. This bifid sternum, like the bifid spine and the remaining examples of the symmetric category of Serres, depends on the arrest of growth.

When M. Groux's arms are not extended, and the pectoral muscles are relaxed, this depression is an inch in width when measured at the termination of the third rib. The integuments pass into and across this groove, and present no alteration of structure or adhesion; they can be pinched up and drawn outwards in a fold without any indication of the existence of a dense fascia or expansion beneath; into this groove the hollow at the lower portion of the neck is continued, uninterrupted by any bounding osseous line or inter-clavicular ligament; the sternal ends of the clavicles are small; the sternal portions of the sterno-mastoid muscles are not deficient, nor are their sternal tendons, which are inserted into the edges of the bone immediately beneath each clavicle. The groove is closed transversely, and at the lower part by the ensiform cartilage, which is flat, broad, very firm, and overlapped on each side by the sternal ridges, with which it is connected by a strong but elastic medium. This is rendered very evident when M. Groux raises or throws back his arms, or when, having fixed the latter, he puts the pectoral muscles, which are well developed, into strong action: the fissure then becomes expanded to a width of nearly three inches. When, on the contrary, the shoulders are brought forward, the fissure becomes nearly closed, and the clavicles touch and even overlap each other.

Before proceeding to describe the most remarkable feature in this case, namely, the existence of a visibly pulsating tumour in the upper and middle parts of this fissure, we have to observe that there is no evidence, either from symptoms or physical signs, of the existence of any diseased condition of the heart, the great vessels, or the lungs. There is no visible pulsation in the veins of the neck. But a question might arise, namely, whether the organs of circulation might not themselves present some form of congenital malformation or malposition. On this point we have come to the conclusion that evidence of any of these conditions which might be expected in such a case—namely, defect of me-

sial union—does not exist. There is nothing to lead us to suspect that any malformation by defect exists in the heart.

When the subject is in a state of quiescence, the following phenomena can be observed on inspection and examination of the sternal fissure:—

1st. The existence of a pulsating tumour, of an elongated oval shape, of about two inches in length; it crosses the mesial line obliquely, so as to show about two-thirds of its volume to the left.

2nd. The pulsation of this tumour, though plainly visible at a distance, is by no means forcible. It has not the strength of the systole of a healthy heart, nor yet the force of the beat of an aneurism; and it does not convey the sensation of proceeding from a cavity with thick or solid walls.

3rd. The collapse of this tumour is much more sudden than its protrusion. It appears to be second in point of time.

4th. This collapse or disappearance of the tumour is, however, effected with a progressive movement from above downwards. This is rendered obvious by the observer placing three fingers lightly on the pulsating mass. Their successive elevation shows the course of the movements as above stated.

5th. This pulsation was ascertained to be not synchronous with the beat of the apex of the heart, but to precede it by a slight though appreciable interval of time.

6th. The diastolic movement seems to take place in a direction from the left and behind, forwards and to the right.

7th. On applying the finger lightly over this tumour, the pulsation is observed to be single.

8th. On more deep and forcible pressure backwards and slightly to the left side, a double stroke is felt.

9th. On deep pressure backwards in the upper part of the fissure, a distinctly double pulsation can be perceived.

10th. This second pulsation, we submit, is that of the arch of the aorta, of the innominata, or of both.

11th. This pulsation (that of the arch of the aorta) follows, by the shortest appreciable interval, upon that of the heart's apex.

12th. It is also consecutive, but by a more prolonged and sensible interval, to the pulsation of the oval-shaped tumour.

13th. The order of succession of the phenomena here described is well displayed and confirmed by the application of the sphygmoscope.

14th. The heart was examined with the stethoscope in the usual situation, and presented the ordinary first and second sounds, quite devoid of any abnormal character in tone or rhythm.

15th. Auscultation over the seat of the aorta gave the two sounds peculiarly well defined, the second in particular being remarkably clear in this situation.

16th. In no part of the cardiac region, or in the line of the great vessels, was any murmur or other abnormal sign discoverable.

17th. Occasionally the second sound lost its usual definite and sin-

gle character, and assumed a complex character, approximating to reduplication, and containing at least two elements of sound. This was observed towards the close of the examination, when M. Groux was somewhat fatigued.

The pulsations of the oval tumour were examined with great care, and with the following results:—

At our first examination, when we used an ordinary stethoscope, we were not able to discover any *special* single sound, attending the diastole of the tumour. The ordinary double sounds of the heart were heard, without any departure from their normal character, except that the first sound had a slightly muffled character.

But on our second examination we came to the following conclusions:—

When an observation was made with the flexible stethoscope of M. Groux, the bell being simply placed in apposition with the tumour, and pressure being, as far as possible, avoided, a single sound was evident. This single sound was replaced by a double sound on making even a slight degree of pressure, but its distinctly single character could be reproduced at pleasure by removing the pressure.

Under these circumstances, taking the three points or centres of sound in the fissure, from above downwards, or from below upwards, they might be enumerated as follows:—

Double sound,	corresponding to	Aorta.
Single sound,		Left auricle.
Double sound,		Right venricle.

The succession in point of time is, as before stated, as follows:—

Tumour.
Ventricle.
Aorta.

There is a peculiarity belonging to this sound (of the oval tumour) which, without offering any explanation of it, we think it right to record:—

The first impression it gives is that of a single, complete, and instantaneous sound, somewhat analogous to that observed in aneurisms with a single beat. But, on more careful and delicate analysis of its characters it is found not to be instantaneous, but to rise progressively, though still in the shortest possible interval of time, from a minimum to a maximum, conveying the idea that its cause is a vermicular rather than an instantaneous or perfectly sudden action. This character is found most evident in the very uppermost part of the tumour.

It was observed that the character of this sound (sound of tumour) was not constant: it seemed to have certain periods of a maximum intensity, and again of a minimum; there was a certain relation not easily determinable to the inspiratory or expiratory efforts. A peculiar whiff was occasionally observable, but under what precise conditions did not admit of being defined.

We have studied the enlarged condition of the oval tumour produced by M. Groux, after deep inspiration, followed by suspension of further respiratory effort. It has appeared to us, under this condition, to reach at least three times its ordinary volume: and this circumstance, were there no other, furnishes a strong argument in favour of the opinion that the tumour in question is the right auricle. In the distended state the pulsation becomes feeble, irregular, and fluttering, and apparently more rapid.

18th. By certain respiratory efforts M. Groux can arrest the radical pulse in both wrists.

19th. There is a peculiar condition of the heart's action induced in M. Groux by certain respiratory efforts, which is worthy of notice, though not bearing upon the main question upon which we have been appointed to report. It is the production of a strong pulsation at the left side, and referrible to the body of the heart. To induce this, M. Groux makes use of the following succession of actions. He takes a very deep inspiration, and then, by a long regulated expiratory effort, expels the air from his lungs as far as it appears possible to carry this process. Towards the close of this expiratory effort the pulsation of the heart is felt with great force, and with a kind of struggling motion, in the third, fourth, and fifth intercostal spaces, between the left border of the sternum and a line passing vertically through the left nipple. During this time the stethoscope, placed on the anterior part of the right side of the chest, seemed to indicate a period of apnœa, while a loud muscular murmur, apparently referrible to the action of the intercostals, was heard.

If it be assumed that in this case there is no abnormal condition of the heart or great vessels, we may inquire what is the actual nature of the pulsating tumour.

The possible causes of a pulsation in the sternal region may be enumerated as follows:—

I. The pulsation of the base of the heart itself, and principally of that of the right ventricle.

II. The pulsation of the pulmonary artery.

III. The pulsation of the aorta.

IV. The action of the right auricle.

Against the first hypothesis there is to be urged:—

a. The want of synchronism between this pulsation (that of oval tumour) and the impulse in the left infra-mammary region.

b. The singleness of the pulsation.

c. The direction of the action of the tumour, which is from above downwards.

The following considerations lead us to reject the second supposition:—

1. That this pulsation precedes the stroke of the heart.
2. That it is single, and from above downwards.

3. That a double pulsation or action may be felt on deep pressure over the tumour.

4. That when M. Groux suspends his respiration, the tumour acquires a volume far beyond what could be supposed to be attainable by the pulmonary artery, even at its origin.

By a similar process of investigation we conclude that it is not produced by the diastole of the aorta. This conclusion is strengthened by the observation that, on making pressure in the inter-clavicular space, the pulsations of the aorta can be felt giving the usual phenomena,—the sphygmoscope also showing the want of synchronism between the beat of the tumour and that of the aorta, the fissure preceding the latter by a distinct interval.

We hence conclude that this remarkable pulsation can be only that of the right auricle. Its general character and appearances coincide remarkably with those which belong to the auricular actions as seen in vivisections; and all its phenomena are explicable on this hypothesis. For the sake of clearness we shall here recapitulate the reasons which lead us to conclude that the oval body is the right auricle.

1st. Its situation, which is neither that of the base of the ventricles nor the arch of the aorta.

2nd. The progressive, or, as it were, vermicular action of the pulsation.

3rd. Its singleness of sound.

4th. The sensation which it conveys of being a cavity with thin walls.

5th. Its remarkable enlargement when respiration is suspended.

6th. Its precedence of the ventricular impulse.

Robert Harrison.
Robert Law.
William Stokes.
Robert D. Lyons.

Dr. Law said, that, as a member of a profession peculiarly interested in the advancement of the science of Physiology, he felt that he ought to express his obligations to the Academy for the readiness with which it had acceded to the suggestion of appointing a Commission to inquire into the case of M. Groux, which presented so favourable an opportunity of investigating some of the most important phenomena of the circulation and the heart's action. In the conduct of the Academy on this occasion Dr. Law recognised an admission that Physiology had its place amongst those sciences that it was intended to promote, and that it was not its fault that communications upon so important and interesting a science were so rare in the Academy, but rather reflected on those members from whom such communications might have been expected. Dr. Law observed that Physiology was the basis of medicine as a science; that we acquired our knowledge of it by observation and experiment on living animals. Observation taught us the phenomena which bodies

present immediately to our senses, while experiment discovered to us their mode of existence under circumstances contrived by art,—not the result of natural necessity, but the act of one desirous of extending his knowledge. While we observe, we, as it were, watch Nature; when we experiment, we question her. Dr. Law remarked that nature or accident sometimes provided us with experiments on man, whose results were infinitely more satisfactory and more to be relied on than those deduced from the experiments, even the most artfully contrived, when made on inferior animals; that in the latter case the results were only applicable to human physiology when the animals experimented upon stood in very close zoological relation to man; and, therefore, the analogy could never be so complete as when nature or accident made man the subject of experiment. And, again, the sufferings of the animal the subject of experiment often so modified and affected the phenomena, that they could not be regarded as such as Nature would exhibit under less painful influences. M. Groux' case was one of those in which nature afforded us a facility of both seeing and hearing the actions of the heart more plainly than could be done under ordinary circumstances, when the walls of the chest were normally developed. A similar case to that of M. Groux occurred in a female in France, and who suffered as little inconvenience from it as M. Groux seemed to do. There was in her case, as in M. Groux', a deficiency in the sternum, which allowed the heart's action to be seen. She was beyond the age of thirty when she was the subject of observation. She was then in good health, actively engaged in laborious occupations, and had borne children. Dr. Law instanced, as an example of accident in the human subject supplying a most favourable opportunity of extending our physiological knowledge, the case of St. Martin, with whose history every physician was familiar. This man received a gun-shot wound which penetrated the chest and abdomen, wounding both the left lung and the stomach. He ultimately recovered, with a fistulous opening of the stomach, which communicated externally. Luckily for science, he became the servant of a physician, Dr. Beaumont, who knew how to avail himself of this precious opportunity of investigating the actions of the stomach, and of observing the relative digestibility of different substances which constitute our ordinary food, which he did by withdrawing them at various intervals of time, and seeing the time each required for its complete digestion. Dr. Beaumont's observations made on St. Martin furnish us with the fullest information we possess on the process of digestion. Dr. Law urged, as an additional ground of preference for those natural and accidental experiments on the human subject, the reluctance of the British physician to experiment on inferior animals, except when impelled by imperious necessity,—a plea for which necessity, he felt, was only justifiable when these experiments held out a fair prospect of being directly instrumental to the attainment of a knowledge beneficial to mankind, and which could not be attained in any less objectionable way. The British physician participated in the sentiment of the distinguished Haller, who, when he would justify his experiments on animals, observes:—"Multa ipse peri-

cula feci, invisâ certe mihi crudelitate usus quam tamen utilitas humani generis et necessitas perinde excusant." Dr. Law, as a member of the Commission, hardly felt himself justified in entering into a discussion on the Report, which would necessarily involve technicalities scarcely suited to such a meeting, but would content himself by observing, that its chief topics were amongst some of the most interesting of physiology, and which had been proposed as subjects for investigation by the British Association, viz., "the sounds and motions of the heart." As Dr. Law had been a member of the Commission appointed by the British Association, it afforded him great satisfaction to find in the phenomena exhibited in M. Groux' case a confirmation of those results which had been deduced from the experiments then made, and had constituted the material of the Report. While Dr. Law subscribed to the Report on M. Groux' case, he had no difficulty in understanding why others should not do so. Discrepancies in observations when the senses of sight and hearing are simultaneously engaged, or even separately employed, seem not confined to physiology or medicine: astronomical observations exhibit similar discrepancies. Dr. Law felt that the interest evinced by the Academy towards the Report, and towards the few observations made upon it, would encourage future communications of the same nature.

Dr. Benson said he wished to make a few remarks in connexion with the subject of the Report, of which an abstract had just been read. He was not a member of the Committee, but he had been appointed, with Professors Jacob and Power, by the Council of the Surgical Society of Ireland to examine into the case of M. Groux, and report upon it. This Report he and his colleagues had made at a meeting of the Society, held in the College of Surgeons, on the 13th of March, and which was printed in the "Dublin Medical Press" of the 31st March. He (Dr. Benson) was very well pleased with the result of his investigations. They did not, indeed, bring to light anything very novel, nor establish any new facts; but they did what was better—they confirmed the opinions generally entertained respecting the actions and sounds of the heart. The opinions to which he alluded were those published by a Committee of the British Association after its first Meeting in Dublin, and founded upon experiments then made. He agreed with the authors of the Report, just now read, that the large, prominent, pulsating tumour in the fissure of M. Groux' sternum is the right auricle. It swells out suddenly as the concurrent effect of three causes:—1st, the influx of blood from the cavæ; 2nd, the reflux of blood from the right ventricle, or, at all events, the wave pushed back by the tricuspid valves; and, 3rd, the distention of the pulmonary artery behind it. He thought it very strange that distinguished men in London had differed so much as to the name to be given to this tumour,—one calling it the aorta, others the right ventricle,—while it seemed most obvious that the aorta could be felt (not seen) pulsating higher up, and the ventricle could be felt (not seen) pulsating lower down, all in the same fissure. M. Groux told him (Dr. Benson) that all the medical men who examined him in Dublin agreed that the central prominent part above mentioned was the left auricle, which quite coincided with his (M. Groux) own convic-

tion. Dr. Lyons mentioned that Dr. Corrigan, a distinguished member of his Committee, had not signed the Report, not agreeing with the other members upon a point connected with the pulsation in that auricle. He (Dr. Benson) was inclined to think Dr. Corrigan's opinion was the correct one; but he would request Dr. Lyons to state that opinion again, as he was not sure that he had collected it accurately from the very short abstract of the Report read. [Dr. Lyons explained].

Dr. Benson resumed, and said that the opinions of the gentlemen who examined the case with him were very much divided. Two sounds were certainly heard when the stethoscope was pressed firmly back upon what he believed to be the origin of the pulmonary artery. All subscribed to that. But when the instrument was placed lightly on the auricle, sometimes one sound was heard, sometimes two, and sometimes none. One heard a splashing sound, another a rubbing, and so on. There was no agreement as to the number or character of the sounds; and, for his own part, he rather thought there was no sound, strictly speaking, produced in the auricle. The sounds which he sometimes heard might have depended on the friction of the skin against the instrument, or by the ripple caused by pressure, or they may have been conducted by the auricle from neighbouring parts.

He added, it was a curious fact that the sounds of the heart were better heard in most other individuals than in M. Groux: the sternum formed a kind of sounding-board, which rendered the sounds more audible in others; but the advantage in M. Groux's case was that they were more defined and localized.

Dr. Henry Kennedy said he had arrived at the conclusion that the tumour seen in the centre of the fissure could be none other than the right auricle, or a portion of it. He founded his opinion mainly on the anatomy of the heart itself; for no other cavity of the organ would admit of the same great and rapid dilatation which was seen when M. Groux pleased to render it prominent; but, besides what the sight took cognizance of, there was also sensible, to a gentle pressure, a very peculiar vermicular motion; and the auricle would exactly be, from its structure, the kind of cavity which would generate such a movement. From these arguments he felt satisfied that the central tumour was caused by the right auricle, and the phenomena present appeared to him to admit of no other explanation. He begged to state further his impression that in M. Groux' case the right heart was, most probably, above the natural size. Any one who had seen him exhibit could easily understand how this would be brought about. It was well known, too, that the pearl-divers were all short-lived, and this was due directly to affections of the right heart. In the present instance his opinion was founded on the very great distances which existed between the three centres of pulsation.

It was proposed by W. R. Wilde, Esq., and seconded by Geo. Petrie, LL. D., and passed unanimously,—

That the Report of the Commission be received by the Academy; and that the thanks of the Academy be given to the members of the Commission.

DUBLIN UNIVERSITY ZOOLOGICAL AND BOTANICAL ASSOCIATION.

Professor W. H. Harvey, M.D., F.R.S., read a paper (*vide* p. 264)—

ON A NEW MYRTLE. (PLATE XXII.)

Hypocalymna (*Cardiomyrtus*) *Phillipsii:* ramis junioribus ferrugineo-tomentosis teretibus; foliis oppositis oblongo-ovatis basi subcordatis sessilibus semi-amplexicaulibus obtusis margine plano cartilagineo-denticulatis uninerviis viridibus pellucide punctatis; floribus axillaribus solitariis (v. geminatis ?) pedunculatis, pedunculo pubescenti brevi.

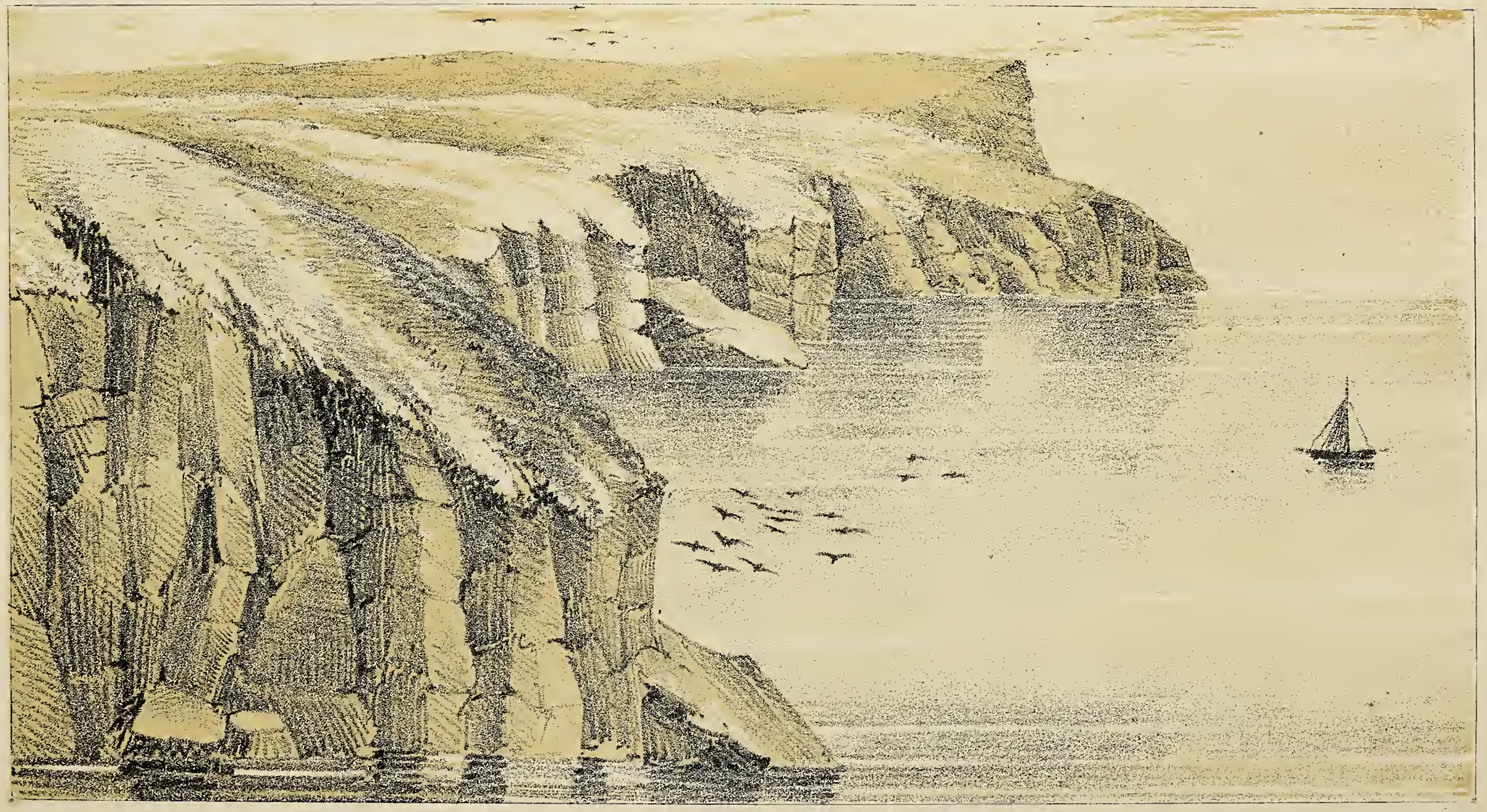
The seeds came from Mr. Phillips, of King George's Sound.

A shrub 3–4 feet high or more, densely leafy. *Branches* frequently forking from the abortion of the terminal bud and the development of the lateral buds, terete, the younger ones clothed with a short, ferruginous pubescence or tomentum. *Leaves* in pairs, about an inch apart, deussating, 1 or $1\frac{1}{2}$ inch long, $\frac{3}{4}$ inch wide, oblong-ovate, subcordate at base and partly amplexicaul, sessile, horizontally patent, somewhat wavy, glabrous, pellucid-dotted with a cartilagineo-membranous serrulate margin, one ribbed, with immersed pinnating and intra-marginal veins. *Peduncles* axillary, geminate (?), (in our specimen only one is developed), 2–4 lines long, terete, pubescent. *Bracteæ* subtending the base of each peduncle, and two at the base of the calyx, where that is articulated to the peduncle. *Calyx tube* turbinate, rather shorter than the limb. Sepals 5, oblong-ovate, very obtuse, with scarious entire margins. *Petals* 2–3 times as long as the sepals, ovate, tapering at base into a short claw, concave, very obtuse, pellucid-dotted, marcescent. *Stamens* inserted with the petals in a single series, confluent at base into a broad perigynous ring, very numerous for the genus, 50 or more; filaments filiform, of unequal length, incurved, anthers short, erect, 2-celled; cells parallel, opening longitudinally, with a gland-like, swollen connective, dorsally inserted.

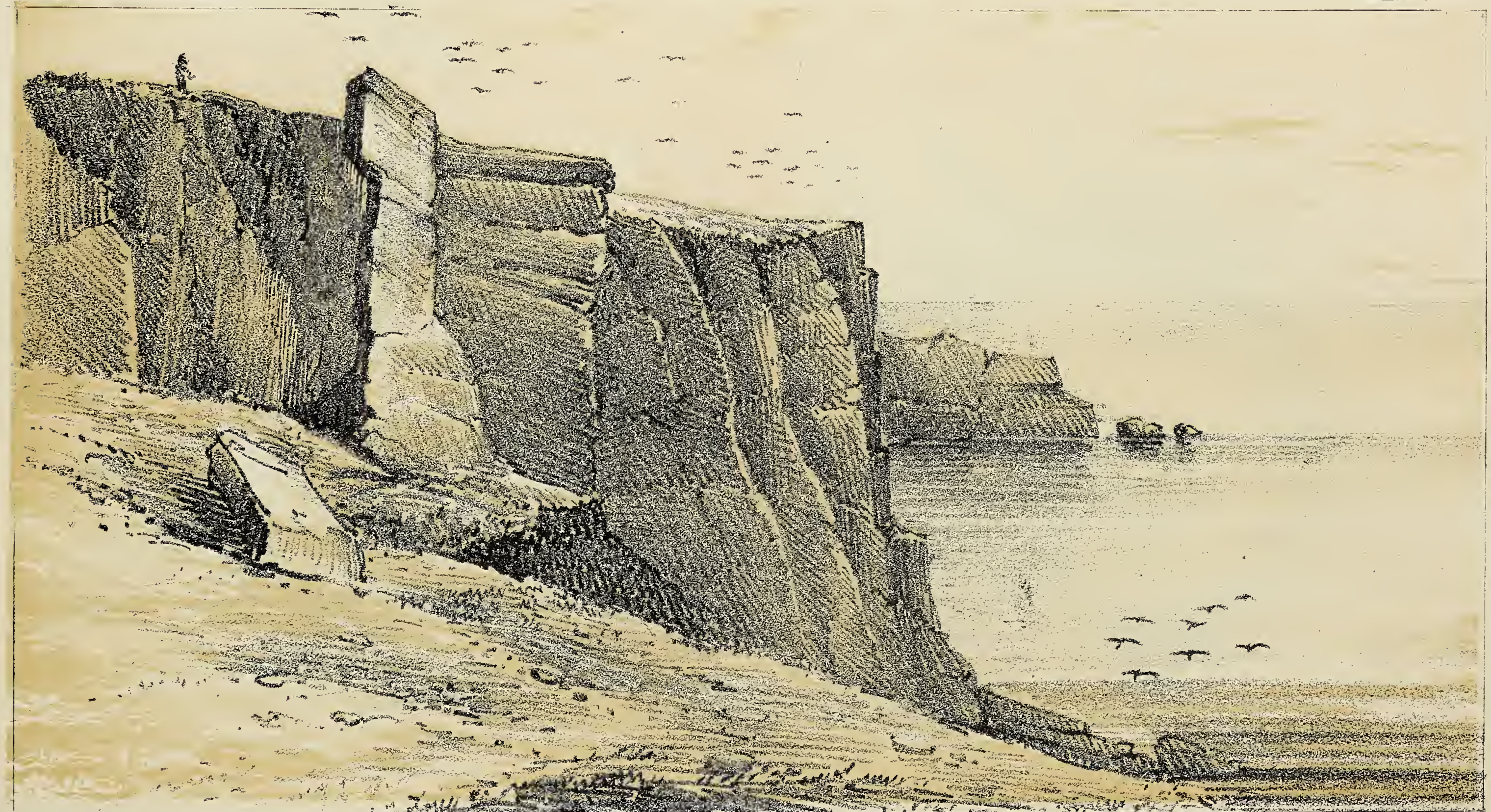
Ovary nearly superior, its base only confluent with the tube of the calyx, but the whole of the ovule-producing portion is free, rising above a broad perigynous fleshy rim, which separates it from the staminal circle, trilocular, and distinctly three-lobed; ovules numerous, about twelve in each cell, fixed to a fungous axile placenta, sessile; style subulate, curved, stigma simple.

This plant seems to agree in all essential respects with Hypocalymna, except that the ovules are more numerous, in which respect it coincides with Astartea; but it differs from that genus in having the stamens monadelphous. In habit it most resembles *Hyp. cordifolium*, but is much larger and more robust, with broad leaves and tomentose terete branches.

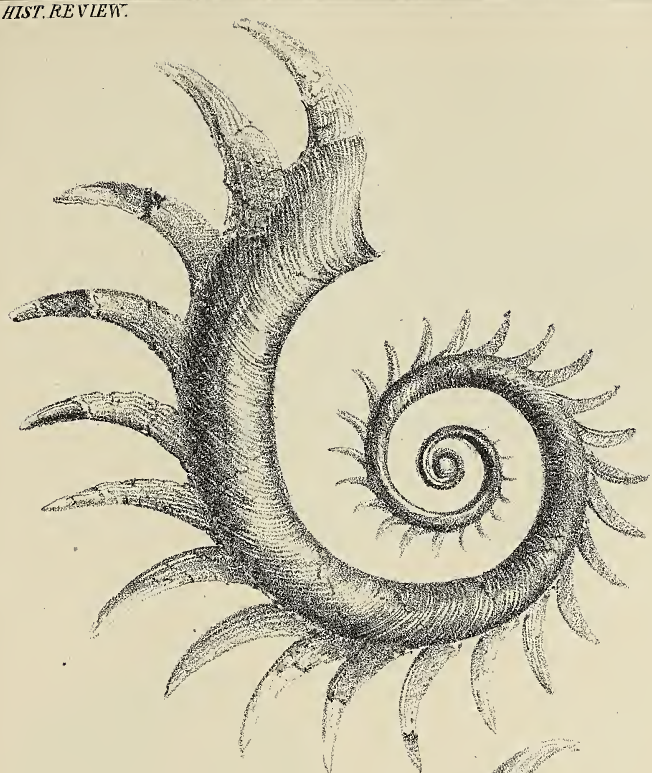
The mere circumstance of a greater number of ovules in each cell, where they vary from one to three in other species, seems hardly sufficient to establish a separate genus for the present species.



RED HEAD, C° WATERFORD. FROM PORTALLY HEAD.
January. 1857.



NATURAL STONE CROSS, AT SWINY HEAD, Co. WATERFORD.
January. 1857.



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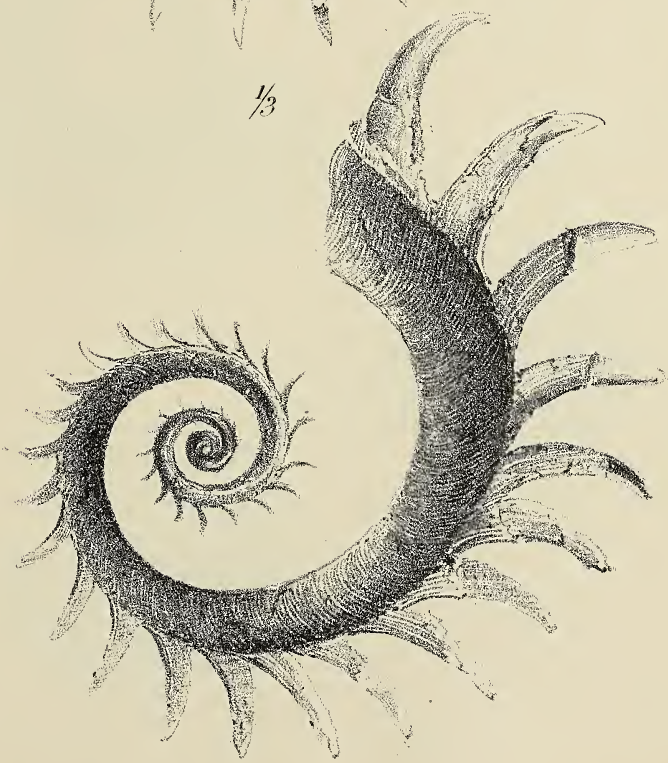

W. C. ad. nat. del. Forster & C° Dublin.

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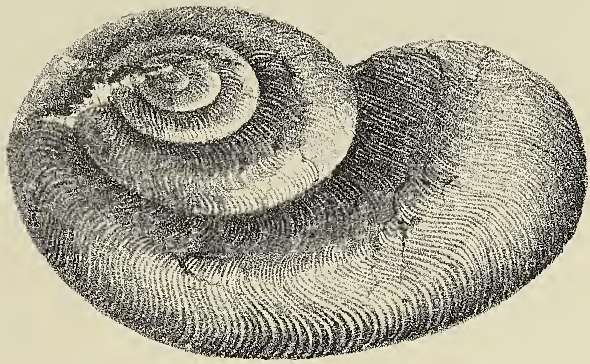

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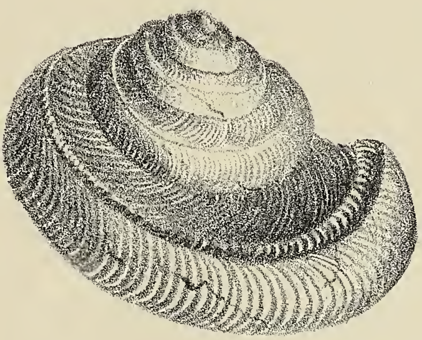

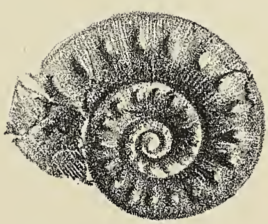

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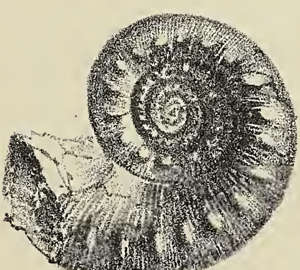


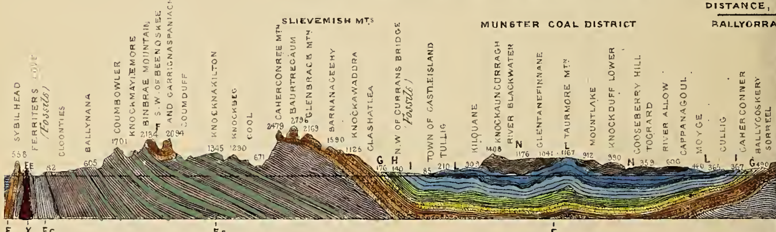
4

W.C. ad nat. del.

Forster & C Dublin.

SECTIONS TO ILLUSTRATE MR GRIFFITH'S PAPER

SECTION IN AN EASTERN AND WESTERN DIRECTION, FROM THE GRANITE OF BLACKSTAIRS MOUNTAIN
SHOWING THE RELATIONS OF THE SILURIAN, OLD RED SANDSTONE AND CARBONIF
AND ESPECIALLY EXHIBITING THE RELATIVE POSITIONS OF THE SEVERAL SE
HORIZONTAL SCALE, TWENTY MILES TO AN IN
DISTANCE,

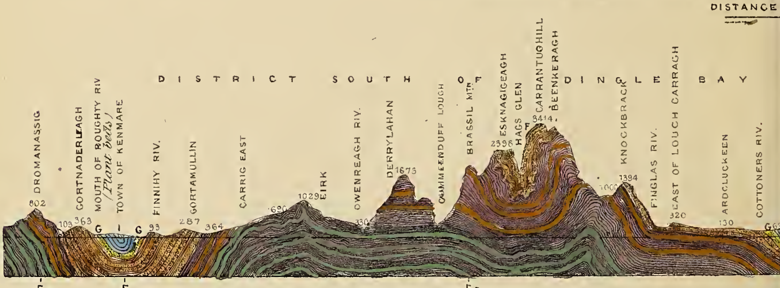


U – *Granite.* X *Greenstone dikes.* Ea – *Schistose Silurians.* Ec – *Fossiliferous Silurian slates and g*
with red, brownish, green or purple slate, (Glengarriff Grits, ? Silurian). F – *Old Red*
Carboniferous Slate, or Lower Limestone shale, (Foss

N

The colours and letters
with those, which have been adop

SECTION FROM BRANDON BAY IN A NORTH EAST AND SOUTH WEST DIRECTION, THROUGH TH
SHEWING THE RELATIONS OF THE GLENGARIFF GRITS AND THE OLD RED S
HORIZONTAL SCALE, FIVE MILES TO AN INC
DISTANCE

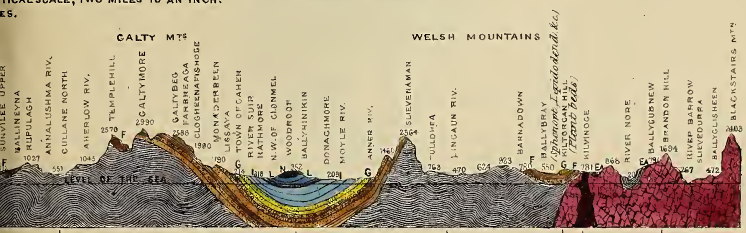


E – *Silurian black slates of Annascall.* Ee – *Chloritic or brownish red grits or conglomerates*
rian). F – *Old Red Sandstone, shale and conglomerate.* G – *Yellow Sandstone with shale, (Pl*

Forster & Co

SEDIMENTARY ROCKS IN THE SOUTH OF IRELAND.

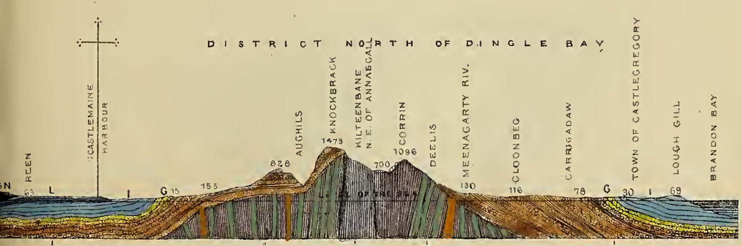
COUNTIES OF WEXFORD AND CARLOW, TO SYBIL HEAD ON THE WEST COAST OF THE COUNTY OF KERRY,
ROCKS OF THE MIDLAND DISTRICTS OF THE SOUTH EAST OF IRELAND;
STRATA, WHICH OCCUPY THE DISTRICT OF THE PENINSULA OF DINGLE.
TICAL SCALE, TWO MILES TO AN INCH.
ES.



ewer.) EE_*Chloritic or brownish red grits or conglomerates, occasionally alternating*
stone, shale and conglomerate. G_*Yellow Sandstone with shales, (Plant beds).* H_
Lower Limestone. L_*Upper Limestone.* N_*Lower Coal Series.*

ference correspond
or the Geological Map of Ireland.

OF KENMARE, TO DROMANASSIG SOUTH OF THE ROUGHTY RIVER IN THE COUNTY OF KERRY,
NE, WHICH OCCUPY THE PROMONTORIES ON BOTH SIDES OF DINGLE BAY.
TICAL SCALE, ONE MILE TO AN INCH.
LES.



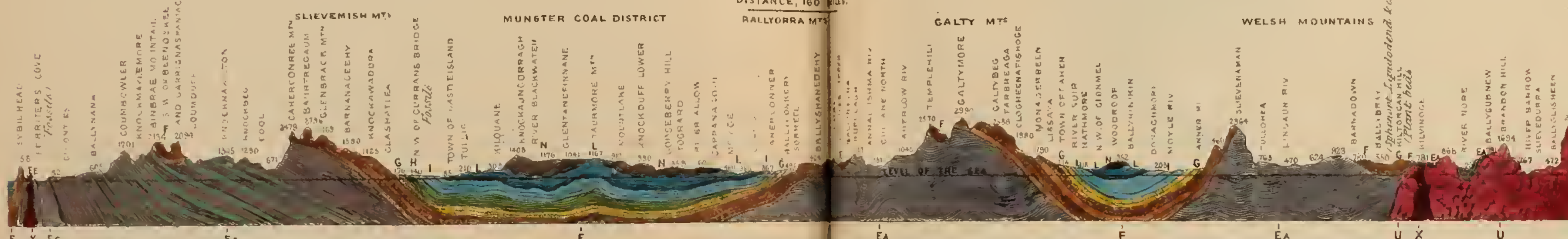
sionally alterating with red, brownish, green or purple slate. (Glengarriff Grits? Silu-
eds). I_*Lower Limestone.* L_ *Upper Limestone.* N_*Lower Coal Series.*

SECTIONS TO ILLUSTRATE Mr GRIFFITH'S PAPER ON SEDIMENTARY ROCKS IN THE SOUTH OF IRELAND.

SECTION IN AN EASTERN AND WESTERN DIRECTION, FROM THE GRANITE OF BLACKSTAIRS MOUNTAIN IN THE COUNTIES OF WEXFORD AND CARLOW, TO SYBIL HEAD ON THE WEST COAST OF THE COUNTY OF KERRY, SHOWING THE RELATIONS OF THE SILURIAN, OLD RED SANDSTONE AND CARBONIFEROUS ROCKS, OF THE MIDLAND DISTRICTS OF THE SOUTH EAST OF IRELAND; AND ESPECIALLY EXHIBITING THE RELATIVE POSITIONS OF THE SEVERAL SERIES OF STRATA, WHICH OCCUPY THE DISTRICT OF THE PENINSULA OF DINGLE.

HORIZONTAL SCALE, TWENTY MILES TO AN INCH _ VERTICAL SCALE, TWO MILES TO AN INCH.

DISTANCE, 160 MILES.



U _ *Granite* X *Greenstone dikes.* EA _ *Schistose Silurians.* EC _ *Fossiliferous Silurian slates and grits.* EE _ *Chloritic or brownish red grits or conglomerates, occasionally alternating with red, brownish, green or purple slate, (Glengarriff Grits, ? Silurian.)* F _ *Old Red Sandstone, shale and conglomerate* G _ *Yellow Sandstone with shales, (Plant beds.)* H _ *Carboniferous Slate, or Lower Limestone shale, (Fossils.)* I _ *Lower Limestone* L _ *Upper Limestone* N _ *Lower Coal Series*

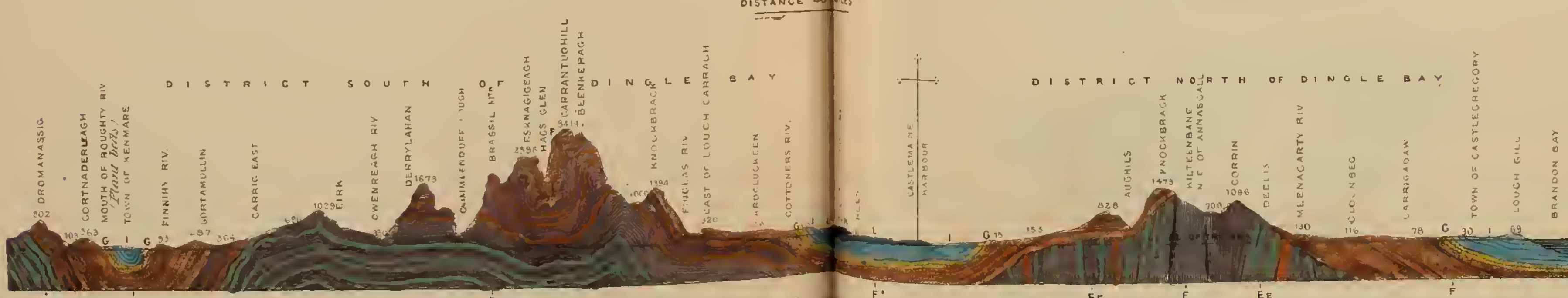
Note.

The colours and letters of reference correspond with those, which have been adopted for the Geological Map of Ireland.

SECTION FROM BRANDON BAY IN A NORTH EAST AND SOUTH WEST DIRECTION, THROUGH THE BAY OF KENMARE, TO DROMANASSIG SOUTH OF THE ROUGHTY RIVER IN THE COUNTY OF KERRY, SHEWING THE RELATIONS OF THE GLENGARIFF GRITS AND THE OLD RED SANDSTONE, WHICH OCCUPY THE PROMONTORIES ON BOTH SIDES OF DINGLE BAY.

HORIZONTAL SCALE, FIVE MILES TO AN INCH. _ VERTICAL SCALE, ONE MILE TO AN INCH.

DISTANCE 40 MILES.



E _ *Silurian black slates of Annascall.* EE _ *Chloritic or brownish red grits or conglomerates, occasionally alternating with red, brownish, green or purple slate (Glengarriff Grits, ? Silurian.)* F _ *Old Red Sandstone, shale and conglomerate.* G _ *Yellow Sandstone with shale, (Plant beds.)* I _ *Lower Limestone* L _ *Upper Limestone.* N _ *Lower Coal Series.*

Fig 1,

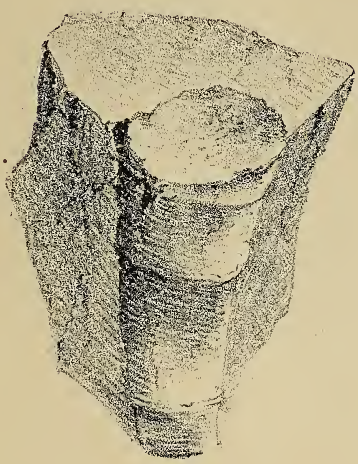


Fig 2,

W. Campbell delt. Lith^d at the Office of D^r Whitty, C.E. Dublin.

Fig 1.

Fig 2.

Fig 3.

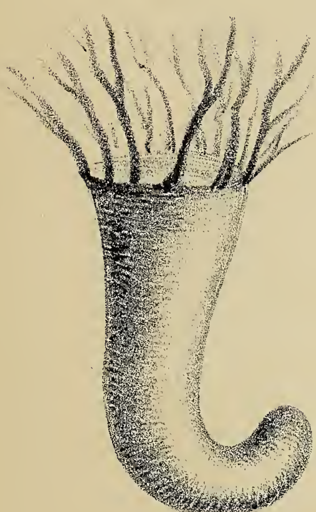


Fig 4.

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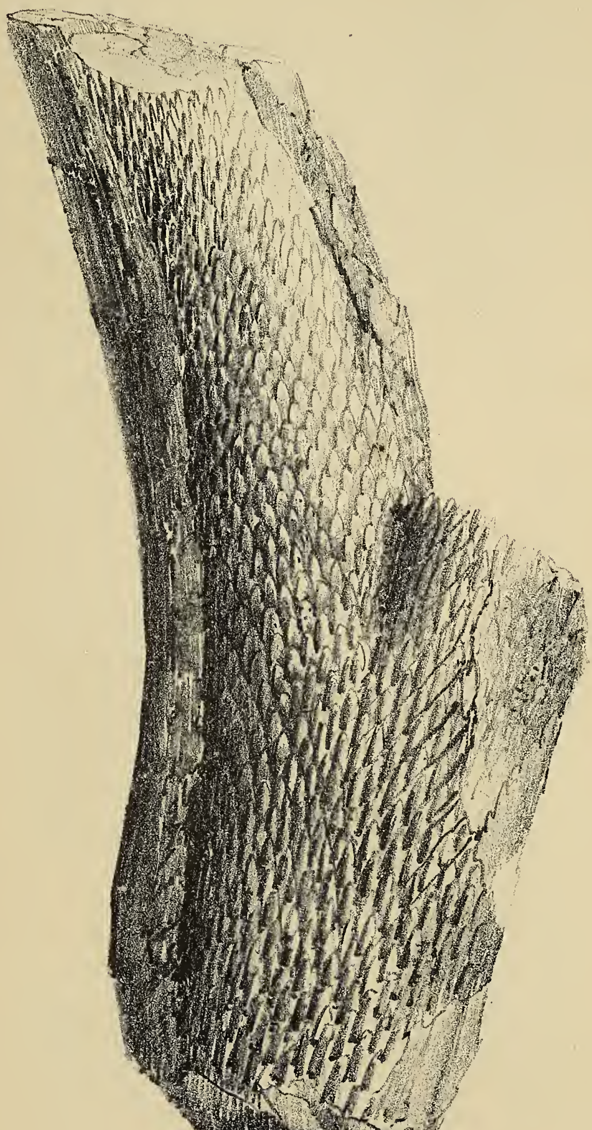

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W. Campbell delt.

Lithd at the Office of Dr Whitty. C.E. Dublin.

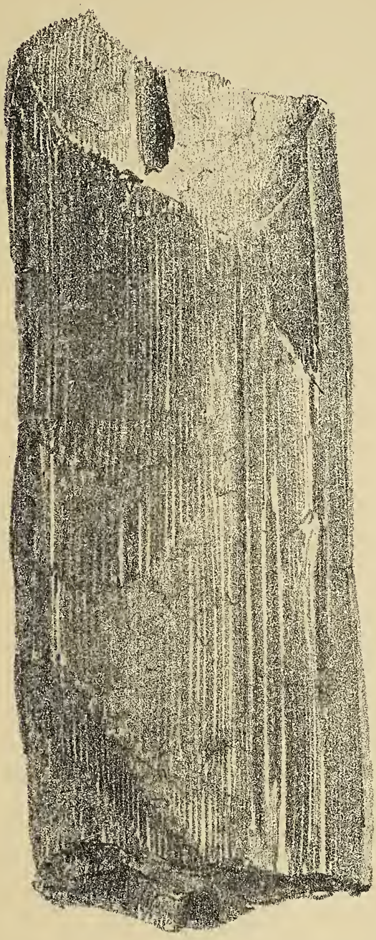

Fig 1.

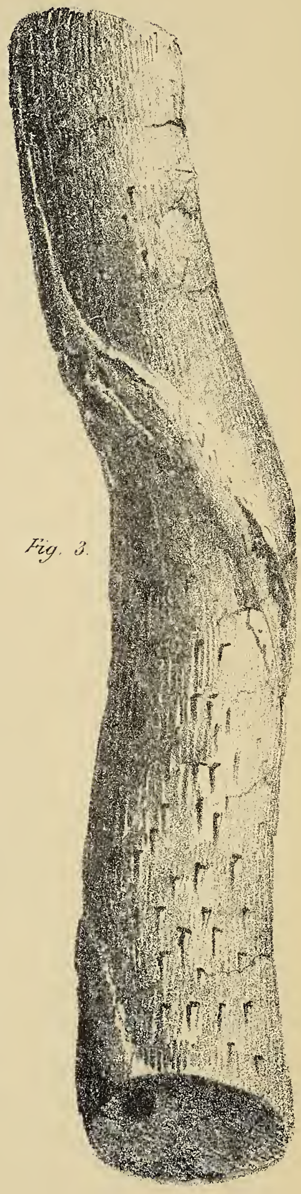

Fig. 3.

Fig. 2

W. Campbell, delt. Lith.[d] at the Office of Dr. Whitty, C.E. Dublin.

Fig 1.

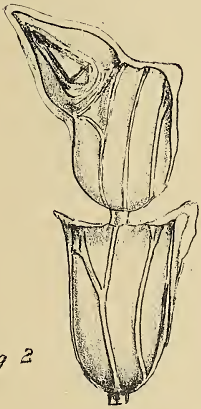

Fig 2

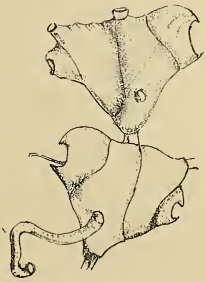

Fig 3.

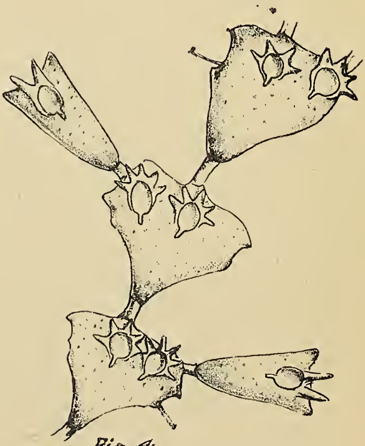

Fig 4.

W. T. ad nat. del. W. H. H. Sculp. Lithd. at the Office of Dr. Whitty, C. E. Dublin.

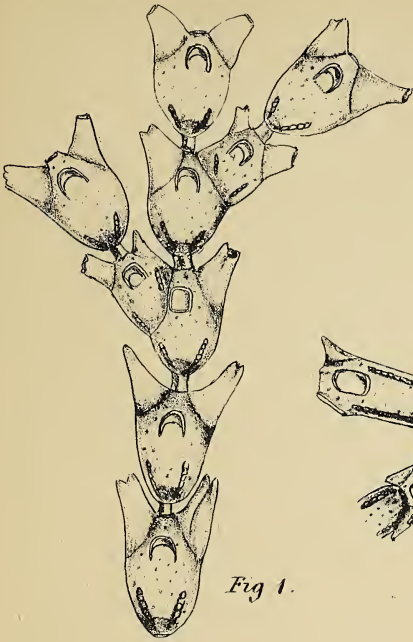

Fig 1.

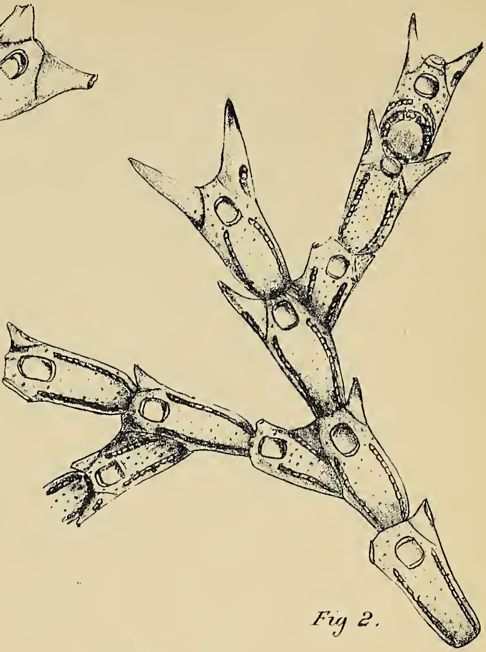

Fig 2.

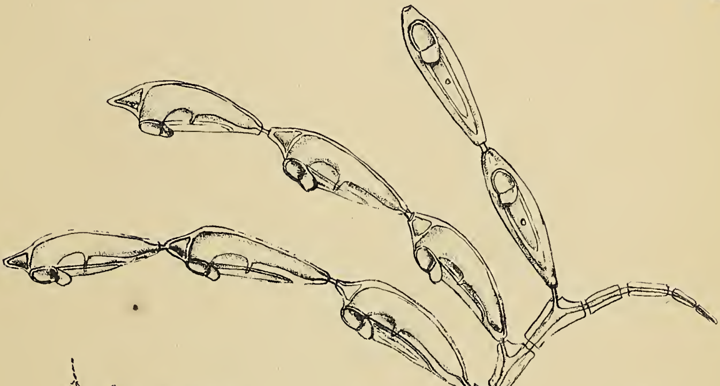

Fig 4

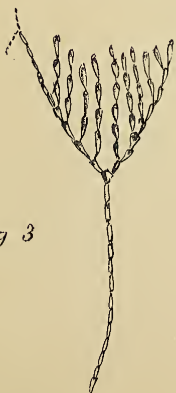

Fig 3

Fig 5.

W. T. ad nat del W. H. H. Sculp. Lith^d at the Office of D^r Whitty, C.E. Dublin.

Fig 1.

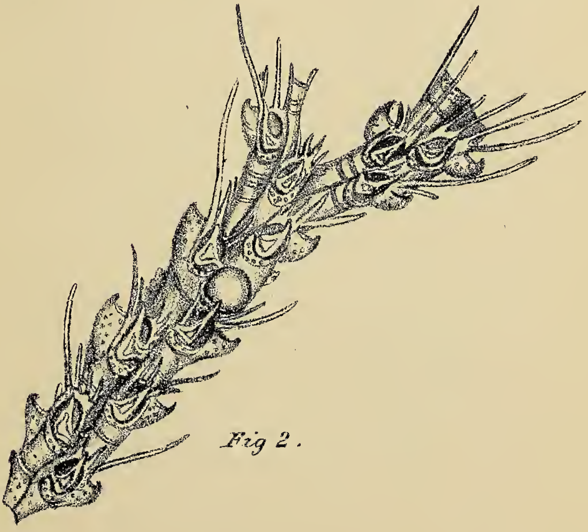

Fig 2.

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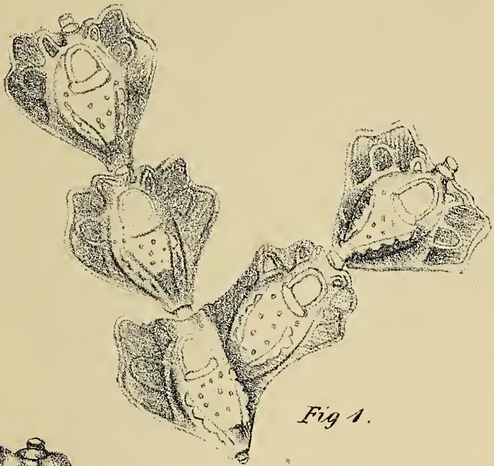

Fig 1.

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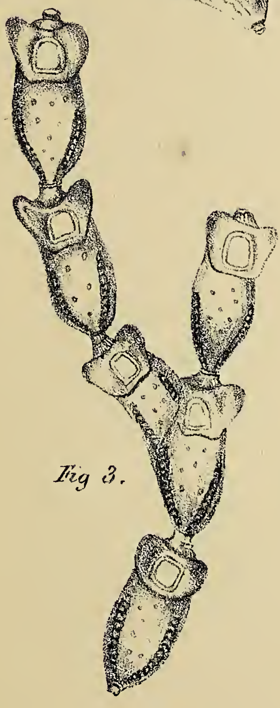

Fig 3.

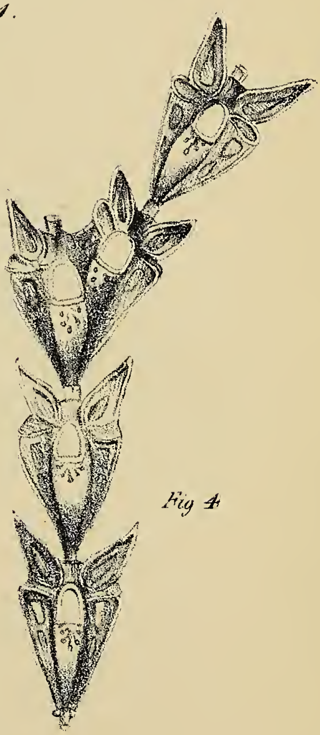

Fig 4.

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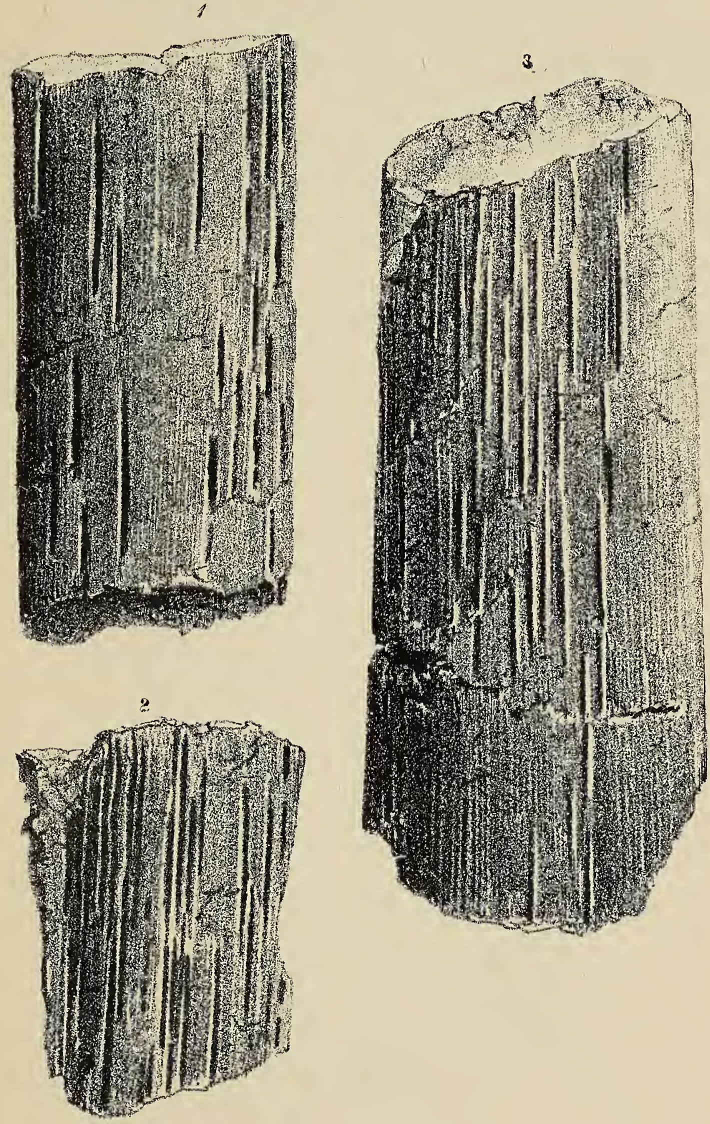

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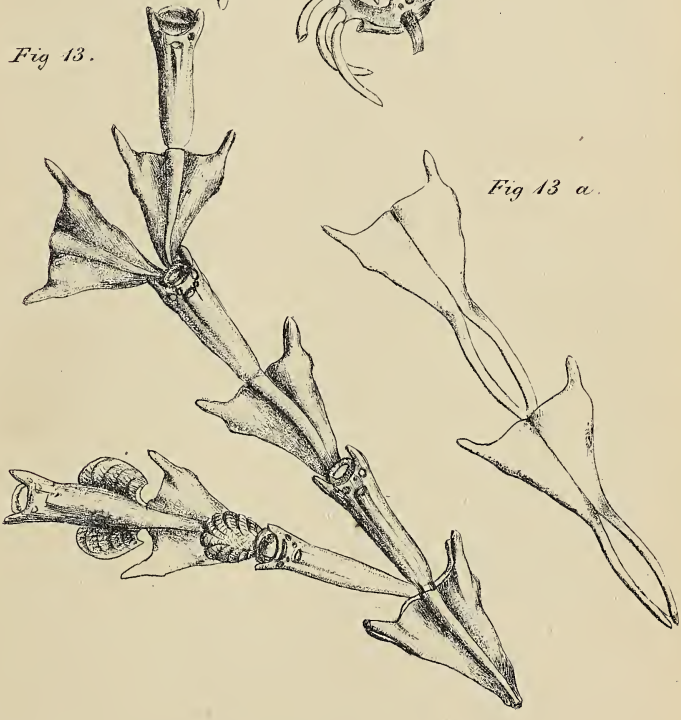

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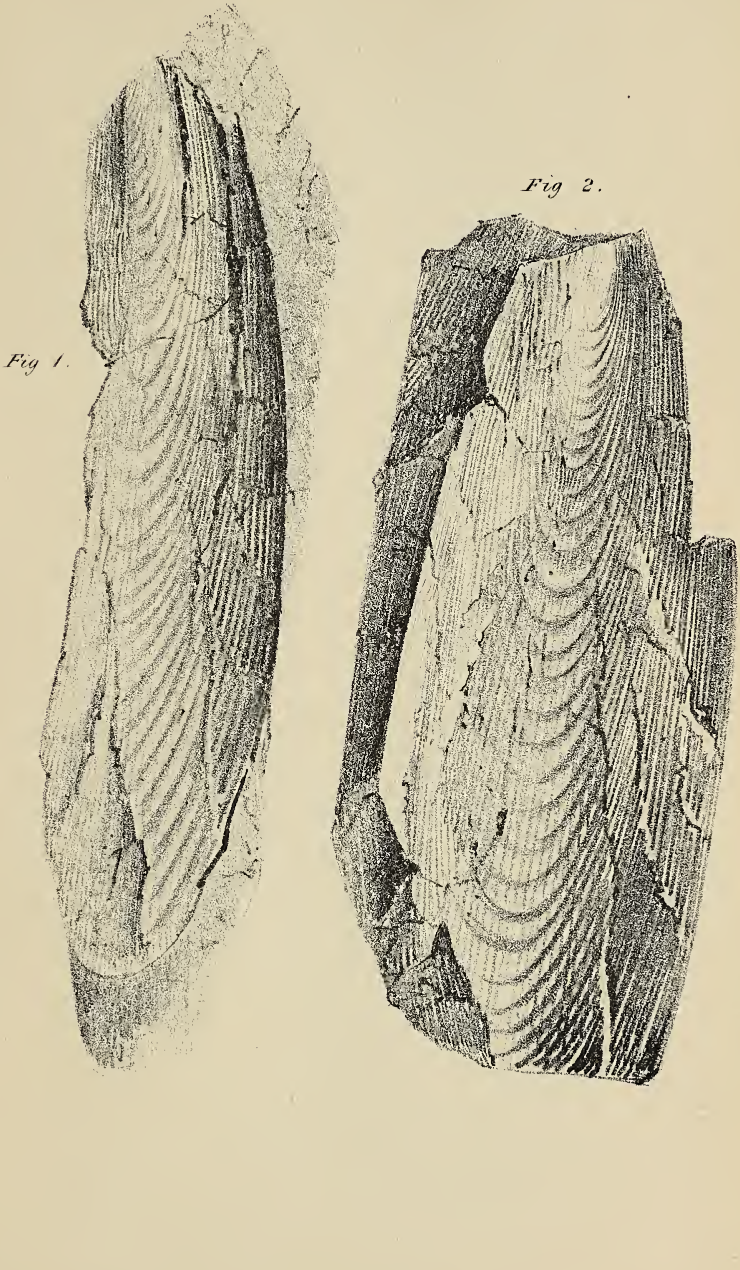

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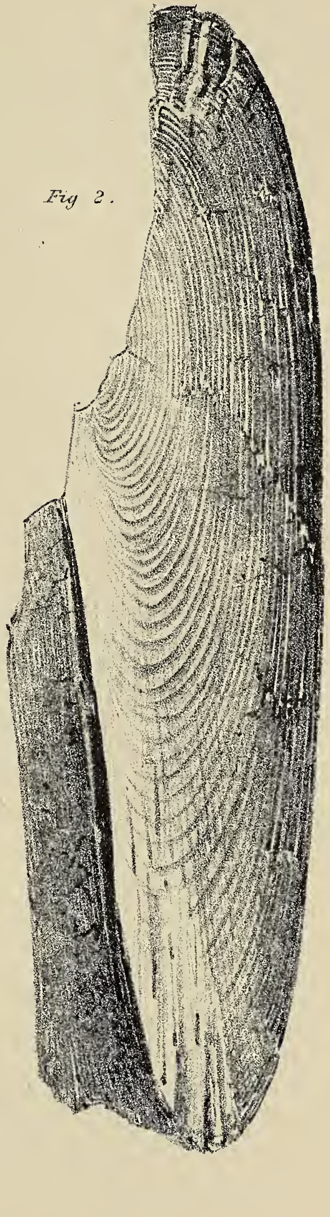

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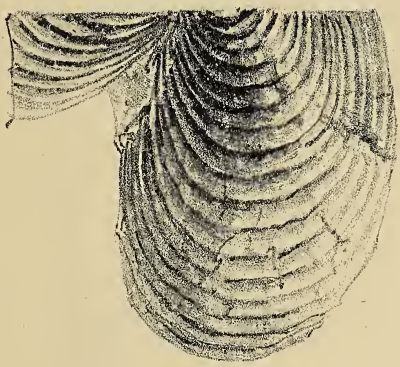

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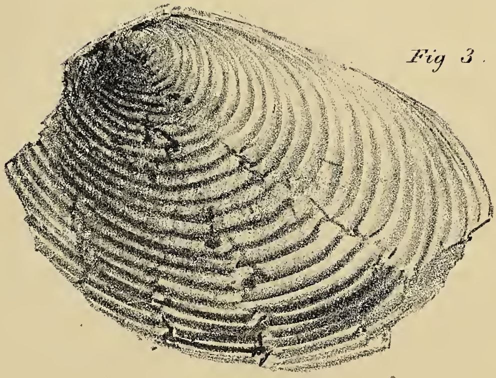

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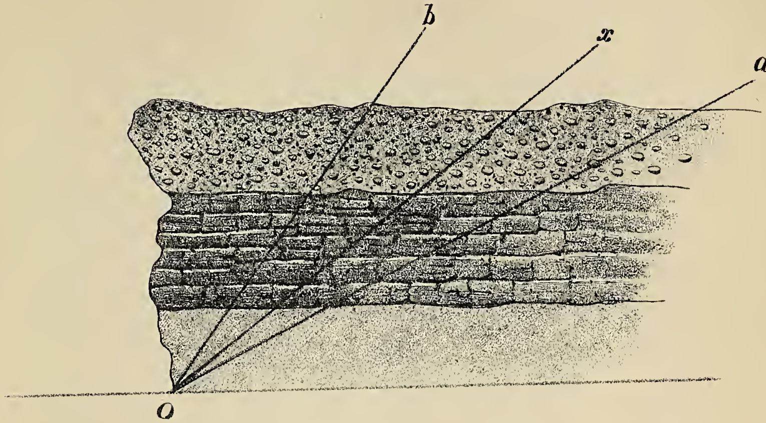

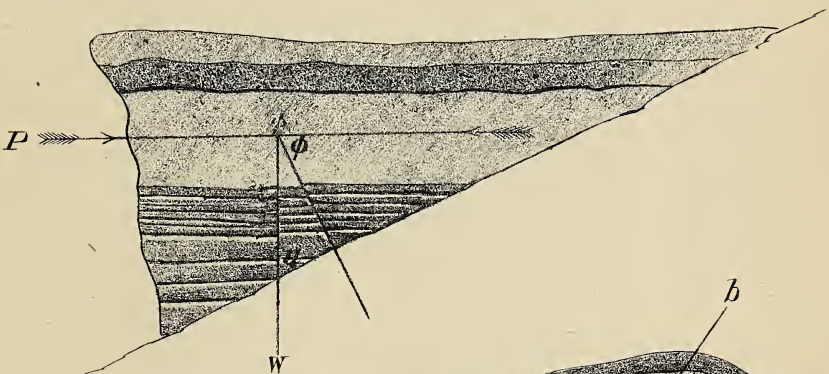

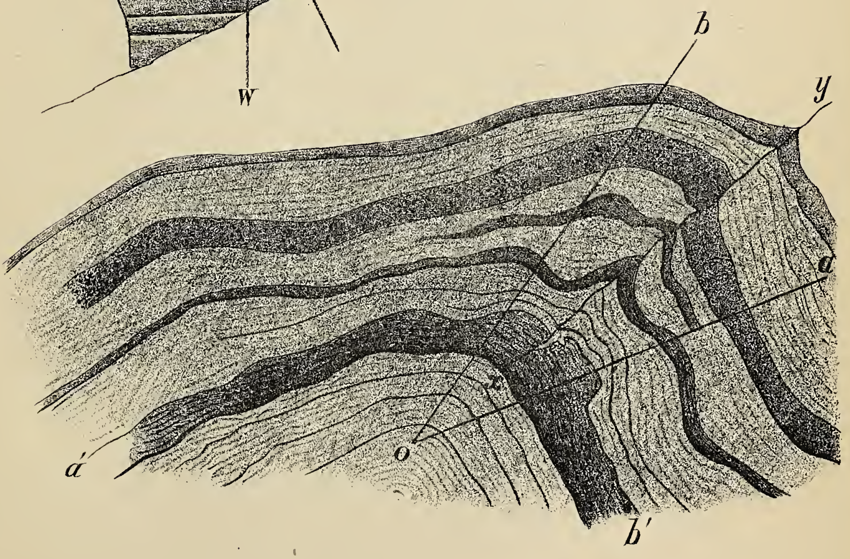

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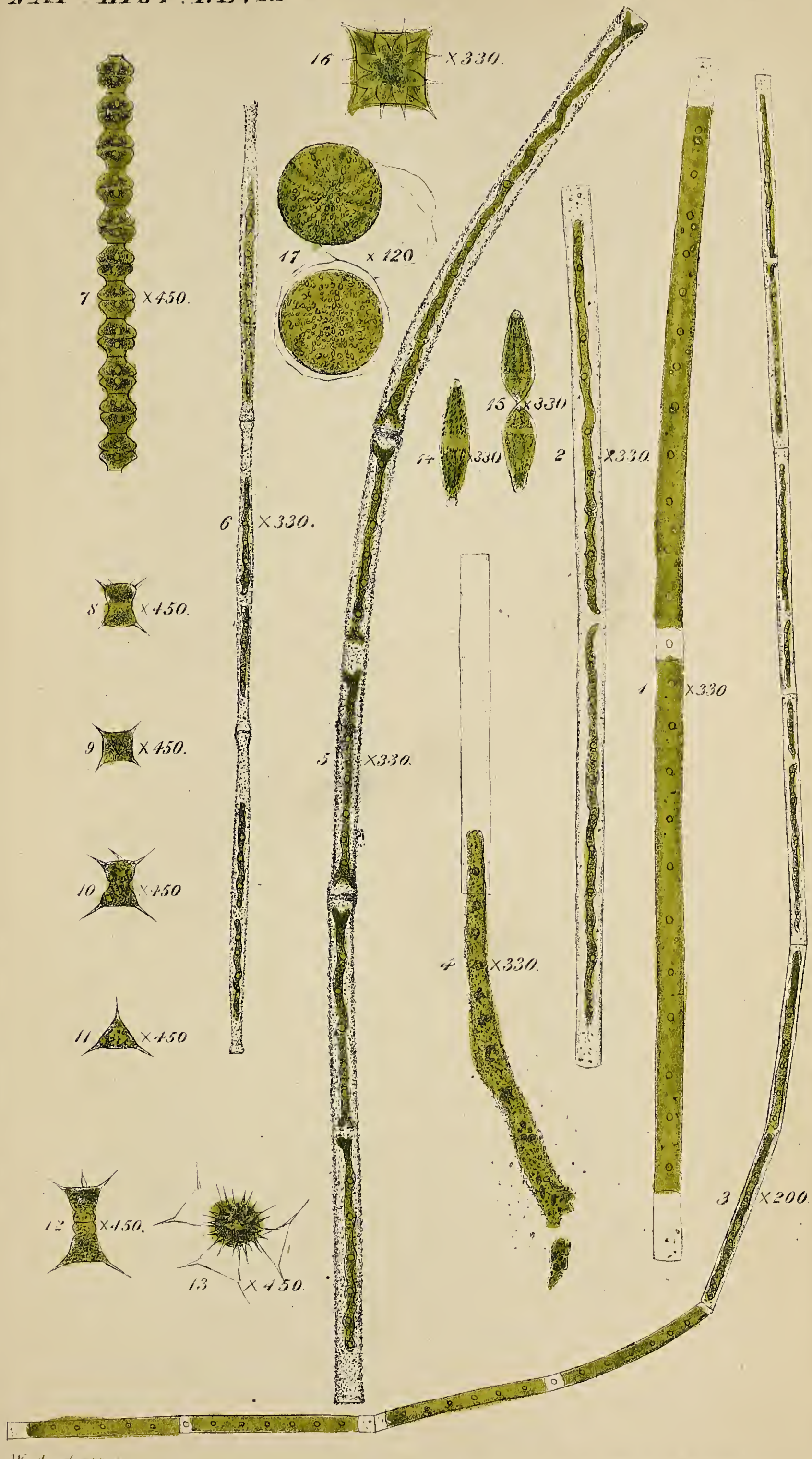

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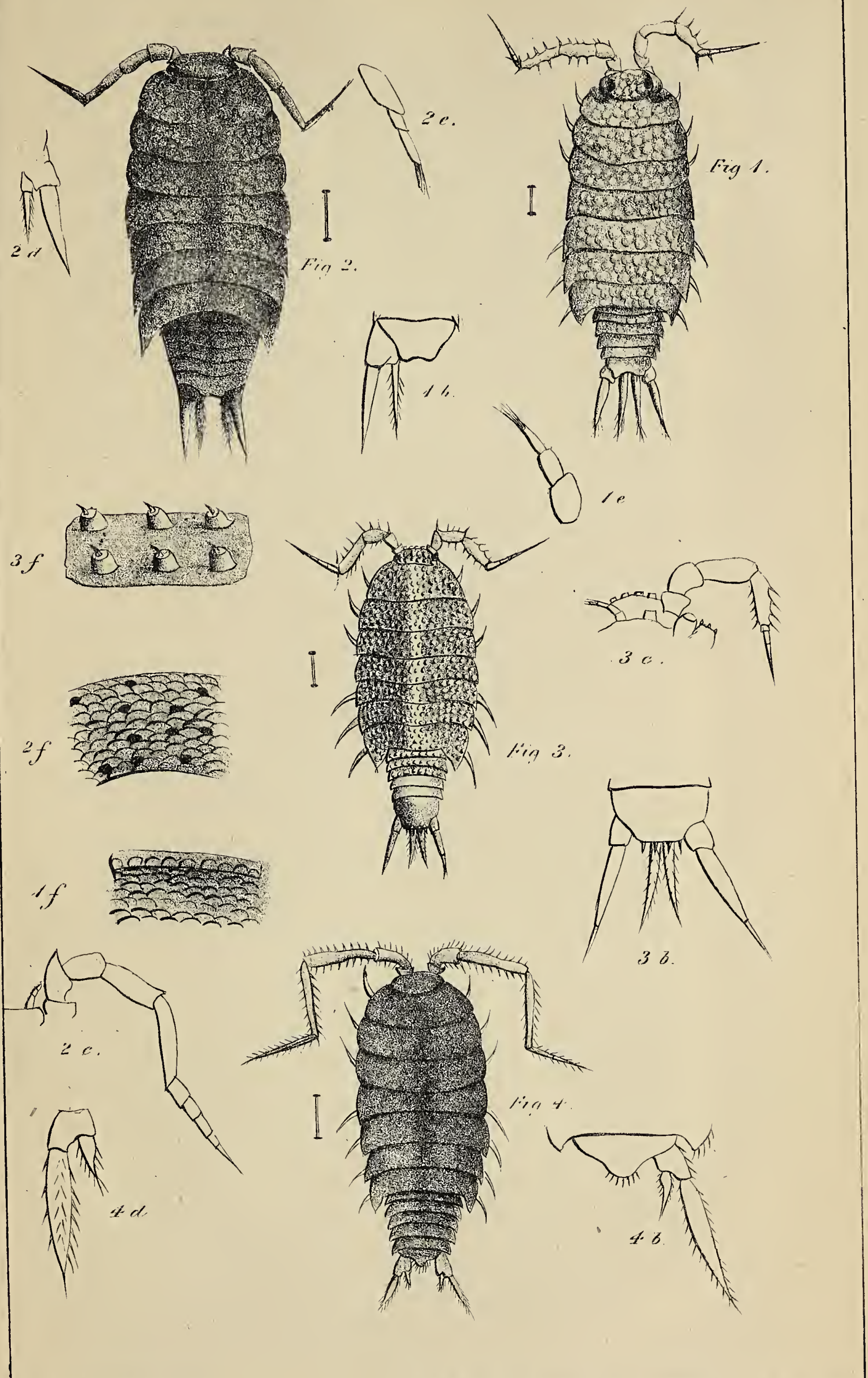

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Vol. I. Part 1.

ARTICLE

1. Synoptical view of the Lichens growing in the vicinity of the City of New York, by Abraham Halsey 3
2. On the Identity of the supposed Pumice of the Missouri, and a variety of Amygdaloid found near the Rocky Mountains, by Edwin James, M.D. 21
3. Description of a New and Gigantic Species of the Genus Cephalopterus, of Dumeril, by S. L. Mitchell, M.D. 23
4. Descriptions of some New or Rare Plants from the Rocky Mountains, collected in July, 1820, by Dr. Edwin James, by John Torrey, M.D. 30
5. Examination of a Mineral from Andover Furnace, Sussex County, New Jersey, by James Renwick. 37
6. Examination of the Acid of the Rhus Glabrum, with Observations on the Juice of the Sambucus Canadensis, as a delicate test, by Issachar Cozzens 42
7. Note on the Organic Remains termed Bilobites, from the Catskill Mountains, by J. E. De Kay, M.D. 45
8. Description of a New Species of Fish, from the Hudson River, by De Witt Clinton, LL.D. 49
9. Notice of a Locality of Yenite in the United States, by John Torrey, M.D. 51

Annals of the Lyceum of Natural History of New York—*Continued.*

ARTICLE
10. Description of a New Species of Siren, with some observations on Animals of a similar nature, by Captain J. Le Conte, of the United States Army, F.L.S. 52
11. Observations on the Megatherium recently discovered in the United States, by Samuel L. Mitchell, M.D. 58
12. An Analytical Table to facilitate the determination of the hitherto observed North American Species of the Genus Carex, by the Rev. Lewis D. de Schweinitz 62
13. Observations on the North American Species of the Genus Utricularia, by Captain John Le Conte 72
14. Notice of New Localities of simple Minerals, along the north coast of Lake Superior, and in the Indian Territory, N. W. from Lake Superior to the River Winnipec, by J. Delafield, Esq., Agent of the United States for Boundaries, &c. 79
15. Description of an Extraordinary Fish, resembling the Stylephorus of Shaw, by S. L. Mitchell, M.D. 82
16. Observations and Experiments on the Seeds of the Cerbera Thevetia, by J. B. Ricord Madianna, M.D. 86
17. An Account of the Columbite of Haddam (Connecticut), with notices of several other North American Minerals, by John Torrey, M.D. . . 89
18. An Account of the Phoca Cristata, recently taken in the vicinity of this city, by James E. De Kay, M.D. 94
19. Appearances on Dissection of the Phoca Cristata, by E. G. Ludlow, M.D., and F. G. King, M.D. 99
20. Observations on the North American Species of the Genus Gratiola, by Captain John Le Conte 103
21. Notes on some New Supports for Minerals subjected to the action of the common Blow-pipe, by Lieut.-Col. J. G. Totten 109
22. On the Remains of the Megatherium recently discovered in Georgia, by William Cooper 114
23. Remarks on certain Entozoical Fungi, by Abraham Halsey . . 125
24. Researches and Experiments on some Species of the Genus Passiflora, by J. B. Ricord Madianna, M.D. 127
25. Notice of Several Species of Shells, by D. H. Barnes. . . . 131
26. Observations on the North American Species of the Genus Ruellia, by Captain John Le Conte 140
27. Account of the Discovery of a Skeleton of the Mastodon Giganteum. Extracted from a Report made to the Lyceum of Natural History, by Messrs. De Kay, Van Rensselaer, and Cooper 143
28. Descriptions of some New Grasses collected by Dr. E. James, in the expedition of Major Long to the Rocky Mountains, in 1819, 1820, by John Torrey . 148
29. On the Hirundo Fulva of Veillot, with some General Remarks on the Birds of this Genus, by Dewitt Clinton 156
30. Facts and Observations connected with the Permanent Residence of Swallows in the United States, by John J. Audubon 166
31. Description of some New Species of North American Insects, by Captain John Le Conte 169
32. Observations on the Structure of Trilobites, and Description of an apparently New Genus, by J. E. De Kay. With notes on the Geology of Trenton Falls, by Professor James Renwick 174
33. Observations on the Manners of the Hystrix Dorsata, or Porcupine of North America, by Frederick S. Cozzens 190

VOL. I. PART 2.

34. Notice of Fossil Crustacea from New Jersey, by Jer. Van Rennselaer, M.D. 196
35. A Sketch of the Geology of the Island of Montreal, by J. J. Bigsby, M.D. . 198
36. Description of a New Species of Grosbeak, inhabiting the North-Western Territory of the United States, by William Cooper . . . 219
37. Observations on the Genus Salamandra, with the Anatomy of the Salamander Gigantea (Barton), or S. Alleghaniensis (Michaux), and two new genera proposed, by R. Harlan, M.D. 222
38. Description of a New Genus of Mammiferous Quadrupeds of the Order Edentata, by Richard Harlan, M.D. 235
39. Remarks on Native Silver from Michigan, by H. R. Schoolcraft . . 247
40. Supplement to a Notice of Fossil Crustacea, by Jer. Van Rennselaer, M.D. 249
41. Descriptions of New American Species of the Genera Buprestis, Trachys, and Elater, by Thomas Say 249
42. Further Observations on the Amphiuma Meaus, by Richard Harlan, M.D. 269
43. Note to a Paper entitled Observations on the Genus Salamandra, at page 222 of this volume 270

Annals of the Lyceum of Natural History of New York—*Continued.*

ARTICLE
44. Descriptions of some New Plants belonging to the Orders Musci and Hepaticæ, by Robert Kaye Greville, LL.D., F.R.S.E., &c. 271
45. Remarks on the American Species of the Genera Hyla and Rana, by Captain John Le Conte 278
46. A Monograph of the North American Species of Carex, by the Rev. Lewis D. de Schweinitz. Edited by John Torrey 283
47. Observations on a Fossil Crustaceous Animal of the Order Brachiopoda, by J. E. De Kay 375
48. Examination of Iron Ores from the Northern Part of the State of New York, by Issachar Cozzens 378
49. Notes on Shells, by D. H. Barnes, No. II. 383

VOL. II.

50. The Genera of North American Birds, and a Synopsis of the Species found within the territory of the United States; systematically arranged in Orders and Families, by Charles L. Bonaparte 7
51. On the North American Plants of the Genus Tillandsia, with descriptions of three New Species, by Captain John Le Conte 129
52. Description of a New Species of Siren, by Captain John Le Conte . . 133
53. Observations on the North American Species of the Genus Viola, by Captain John Le Conte 135
54. Further additions to the Ornithology of the United States, and Observations of the Nomenclature of certain Species, by Charles L. Bonaparte . . 154
55. Some account of a Collection of Plants made during a journey to and from the Rocky Mountains in the summer of 1820, by Edwin P. James, M.D., by John Torrey 161
56. An account of some Experiments on the Root of the Sanguinaria Canadensis, by James Freeman Dana, M.D. 245
57. Analysis of the Copper Ore of Franconia, New Hampshire, with Remarks on Pyritous Copper, by James Freeman Dana, M.D. 253
58. Account of the Dissection of a Proteus of the Lakes (Menobranchus); with remarks on the Siren Intermedia, by J. Augustine Smith . . . 259
59. Description of an apparently New Species of Diodon, by S. L. Mitchell . 264
60. Note on the Habitat of the Schizæa Pusilla of Pursh, by William Cooper . 266
61. Further Discovery of Fossil Bones in Georgia; and remarks on their identity with those of the Megatherium of Paraguay, by William Cooper . . 267
62. Discovery of a Fossil Walrus in Virginia. Report of Messrs Mitchell, J. A. Smith, and Cooper, on a Fossil Skull sent to Dr. Mitchell, by Mr. Cooper of Accomac County, Virginia 271
63. Report on several Fossil Multilocular Shells from the State of Delaware; with Observations on a second Specimen of the New Fossil Genus Eurypterus, by J. E. De Kay 273
64. Notes on a Fossil Skull in the Cabinet of the Lyceum, of the Genus Bos, from the banks of the Mississippi; with Observations on the American Species of that Genus, by J. E. De Kay 280
65. Note on the Murex Corona of Gmelin, by D. H. Barnes . . . 291
66. The Genera of North American Birds, and a Synopsis of the Species found within the territory of the United States; systematically arranged in Orders and Families, by Charles Lucien Bonaparte 293

VOL. III.

67. Chemical Examination of some Minerals, chiefly from America, by Thomas Thompson, M.D., F.R.S. L. and E., &c., Professor of Chemistry, Glasgow; with notes by John Torrey, M.D. 9
68. Remarks on the Prunus Americana of Marshall, by William Darlington, M.D. 87
69. Description of the Species of North American Tortoises, by Major J. Le Conte 91
70. Description of a New Genus of the Order Rodentia, by Major J. Le Conte . 132
71. On the Remains of Extinct Reptiles of the Genera Mososaurus and Geosaurus found in the Secondary Formation of New Jersey; and on the occurrence of the substance recently named Coprolite, by Dr. Buckland, in the same locality, by J. E. De Kay 134
72. Observations on the United States Species of the Genus Pancratium, by Major John Le Conte 142
73. Remarks on the Plants of Europe which have become naturalized in a more or less degree in the United States, by the late Lewis D. de Schweinitz . 148
74. Observations on a Fossil Jaw of a species of Gavial, from West Jersey, by J. E. De Kay 156

Annals of the Lyceum of Natural History of New York—*Continued.*

ARTICLE
75. A Report on some Fossil Bones of the Megalonyx, from Virginia; with a Notice of such parts of the skeleton of this animal as have been hitherto discovered, and remarks on the affinities which they indicate, by Wm. Cooper . . . 166
76. On a New Genus of Serpents, and two New Species of the Genus Heterodon, inhabiting Tennessee, by Dr. G. Troost . . . 174
77. A Monograph of the North American Species of Rhynchospora, by Asa Gray 191.
78. A Notice of some New, Rare, or otherwise Interesting Plants, from the Northern and Western portions of the State of New York, by Asa Gray, M.D. . . 221
79. Monograph of North American Cyperaceæ, by John Torrey . . . 239

Vol. IV.

80. A New Mineralogical Nomenclature, by James D. Dana, A.M. . . 9
81. Fossil Fishes of Connecticut and Massachusetts, with a Notice of an Undescribed Genus, by John Howard Redfield . . . 35
82. Remarks on the Structure and Affinities of the Order Ceratophyllaceæ, by Asa Gray, M.D. . . . 41
83. Notice of the appearance of the Pine Grosbeak, Pyrrhula Enucleator, in the environs of New York, by James F. Ward . . . 51
84. Descriptions of Five Species of Vespertilio that inhabit the environs of the City of New York, by Wm. Cooper . . . 53
85. On Two Species of Molossus inhabiting the Southern U. S., by Wm. Cooper 64
86. On Two Species of Plecotus inhabiting the U. S. Territory, by Wm. Cooper 71
87. Discovery of the Vauquelinite, a rare ore of Chromium, in the United States, by J. Torrey . . . 76
88. An Account of several New Genera and Species of North American Plants, by J. Torrey . . . 80
89. Observations on the Genus Sarracenia, with an account of a New Species, by H. B. Croom . . . 95
90. Melanthacearum Americæ Septentrionalis Revisio, auctore Asa Gray . . 105
91. Monograph of the Species of Pasimachus inhabiting the United States, with descriptions of two New Genera, belonging to the family Carabica, by John L. Le Conte . . . 141
92. Description of a New Species of Apus, by John L. Le Conte . . . 155
93. Description of three New Fossils from the Falls of the Ohio, by I. Cozzens 157
94. On certain Coleoptera, indigenous to the Eastern and Western Continents, by John L. Le Conte . . . 159
95. Description of some New Species of Shells, by John H. Redfield . . . 163
96. Description of New Species of Shells, by John C. Jay, M.D. . . . 169
97. Description of a New Species of Anser, by Geo. N. Lawrence . . . 171
98. A descriptive Catalogue of the Geodephagous Coleoptera, inhabiting the U. S. east of the Rocky Mountains, by John L. Le Conte . . . 173
99. Description of a New Species of Procellaria, by George N. Lawrence . . 475
100. On the Distinctive Characters of Cyprea reticulata of Martyn, and Cyprea histrio of Menschen, by John H. Redfield . . . 477

Vol. V.

101. Descriptions of New Species of Portula and Achatinella, by C. B. Adams.
102. Descriptions of New Species and Varieties of Shells which inhabit Jamaica, by C. B. Adams.
103. Descriptions of New Species and Varieties of Land Shells of Jamaica, with notes on some previously described Species, by C. B. Adams.
104. Descriptions of new Fresh-water Shells which inhabit Jamaica, by C. B. Adams.
105. Catal. of Land and Fresh-water Shells which inhabit Jamaica, by C. B. Adams.
106. Catalogue of Shells collected at Panama, with Notes on their Synonymy, Station, and Habitat, by C. B. Adams.
107. Remarks on the Habitats of certain Species of Land Shells, by C. B. Adams and Edward Chitty.
108. Description of a New Species of Sylvicola, by S. F. Baird.
109. Observations on the Limosa Scolopacea of Say, by John G. Bell.
110. On the Pipilo Oregonus, as distinguished from the Pipilo Arcticus of Swainson, by John G. Bell.
111. Description of a New Species of the Genus Fuligula, by John G. Bell.
112. Description of the Selene Argentea of Lacépède, a fish whose existence has been doubted, by J. Carson Brevoort.
113. Description of a New Species of Helinai, by Jacob P. Girand, jun.
114. Observations on Mr. Bell's Paper on Limosa Scolopacea (Say), by G. N. Lawrence.
115. Description of Mimus Melanopterus, by Geo. N. Lawrence.

Annals of the Lyceum of Natural History of New York—*Continued.*

ARTICLE
116. On the Occurrence of the Caspian Fern (Tylochelidon Carpius) in North America, by Geo. N. Lawrence.
117. Description of a New Species of Tyrannus, by Geo. N. Lawrence.
118. Description of New Species of Birds of the Genera Conirostrum Embernagra and Xanthornus; with a List of other Species not heretofore noticed as being found within the limits of the United States, by Geo. N. Lawrence.
119. Additions to North American Ornithology, No. 1, by Geo. N. Lawrence.
120. Descriptions of New Species of Birds of the Genera Toxostoma Tyrannula and Plectrophanes, by Geo. N. Lawrence.
121. Additions to North American Ornithology, No. 2, by Geo. N. Lawrence.
122. Ornithological Notes, by Geo. N. Lawrence.
123. Synopsis of the Coleopterous Insects of the Group Cleridæ, which inhabit the United States, by John L. Le Conte.
124. Description of New Species of Coleoptera from California, by J. L. Le Conte.
125. Descriptions of two New Species of Fresh-water Shells, by Temple Prime.
126. Descriptions of two Species of Marginella, with notes on sundry Species of Marginella and Cypræa, by John H. Redfield.

VOL. VI.

127. Descriptions of New Species of Birds of the Genera Ortyx (Stephens), Sterna (Linn.), and Icteria (Vieillot), by Geo. N. Lawrence . . . 1
128. Additions to North American Ornithology, No. 3, by Geo. N. Lawrence . . 4
129. Ornithological Notes, No. 2, by Geo. N. Lawrence . . . 7
130. Descriptions of New Species of Helicidæ, by John H. Redfield . . 14
131. Descriptions of New Species of Achatinella from Sandwich Islands, by Dr. W. Newcomb, of Honolulu . . . 18
132. Note to the "Description of the Selene Argentea of Lacépède," at Vol. V. p. 68, of these Annals, by T. Carson Brevoort . . . 30
133. Observations on the Animal of Rotella (Lam.), communicated to the late Prof. C. B. Adams, by the Rev. S. B. Fairbank, of Bombay . . . 35
134. On the Homœomorphism of Mineral Species of the Trimetric System, by James D. Dana . . . 37
135. Descriptions of three New Species of Pisidium, by Temple Prime . . 64
136. On the Identity of Cyclas Elegans (Adams) with Cyclas Rhomboidea (Say), by Temple Prime . . . 66
137. Catalogue of the Terrestrial and Fluviatile Shells of St. Thomas, West Indies, by R. J. Shuttleworth, of Berne, Switzerland . . . 68
138. Note on the Geographical Distribution of the Terrestrial Mollusks which inhabit the Island of St. Thomas, W. I., by T. Bland . . . 74
139. On the Absorption of Parts of the Internal Structure of their Shells, by the Animals of Stoastoma, Lucidella, Trochatella, Helicina, and Proserpina, by T. Bland . . . 75
140. On Proserpina Opalina (C. B. Adams) and Helix Proserpinula (Playfair), by T. Bland . . . 77
141. Description of a New Species of Bird of the Genus Larus (Linn.), by George N. Lawrence . . . 79
142. Descriptions of New Fluviatile Shells of the Genus Melania (Lam.), from the Western States of North America, by John G. Anthony, Esq. . . 80
143. Descriptions of New Species of Shells, by John H. Redfield . . 130
144. Observations on different points of the Natural History of the Island of Cuba, with reference to the Ichthyology of the United States, by Felipe Poey, of Havana, Cuba . . . 133
145. Description of a New Species of Humming Bird, of the Genus Mellisuga (Brisson), with a Note on Trochilus Aquila (Bourcier), by Geo. N. Lawrence . . 137
146. Descriptions of New Species of Achatinella, by W. Newcomb, M.D. . . 142
147. Notes on certain Terrestrial Mollusks which inhabit the West Indies, by T. Bland . . . 147
148. Descriptions of two New Species of Cylindrella from Jamaica, West Indies, by the Hon. E. Chitty, of Jamaica . . . 155
149. Descriptions of four New Species of Terrestrial Shells from Siam, by W. A. Haines . . . 157
150. Descriptions of New Species of Ancylus and Anculosa, from the Western States of North America, by John G. Anthony, Esq. . . . 158
151. Description of a New Species of Bird, of the Genus Sylvicola (Swainson), by Jno. Gundlach, M.D., of Havana, Cuba . . . 160
152. Remarks on the Quantity of Rain at different Heights, by Prof. O. W. Morris, New York . . . 161

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VOL. I. 1837.

Address delivered before the Society, at the opening of their Hall, in Fremont Street, by the Rev. P. W. F. Greenwood 7

ARTICLE

1. Remarks in Defence of the Author of the "Birds of America," by the Rev. John Bachman 15
2. Description of a Gibbon, by Winslow Lewis, junior. . . . 32
3. Cecindelæ of Massachusetts, by Aug. A. Gould . . . 41
4. Chiastolite, or Macle, of Lancaster, by Charles T. Jackson . . 55
5. Observations on a Shell in the Cabinet of the Boston Society of Natural History, supposed to be identical with the Murex Amanus of Linnæus, and the Fusus Probocideferus of Lamarck, by A. Binney . . . 63
6. On certain Causes of Geological Changes now in operation in Massachusetts, by Edward Hitchcock 69
7. Enumeration of Plants growing spontaneously around Wilmington, North Carolina, with remarks on some New and Obscure Species, by Moses A. Curtis . 82
8. Upon the Economy of some American Species of Hispa, by T. W. Harris . 141
9. Descriptions of New North American Coleopterous Insects, and Observations on some already described, by Thomas Say . . . 151
10. Description of a New Animal belonging to the Arachnides of Latreille, discovered in the Sea along the Shores of the New South Shetland Islands, by James Eights 203
11. Chemical Analysis of Chrysocolla from the Holquin Copper Mines, near Gibara, Cuba, by C. T. Jackson 206
12. Description of New Species of North American Hymenoptera, and Observations on some already described, by Thomas Say 209
13. Sketch of the Geology of Portland and its Vicinity, by Edward Hitchcock . 306
14. An Examination of the "Catalogue of the Marine and Fresh-water Fishes of Massachusetts," by J. V. C. Smith, M.D.; contained in Professor Hitchcock's "Report on the Geology, Mineralogy, &c., of Massachusetts" . . 347
15. Chemical Analysis of three Varieties of Bituminous Coal, and one of Anthracite, by C. T. Jackson 357
16. Descriptions of New Species of North American Hymenoptera, and Observations on some already described, concluded, by Thomas Say . . 361
17. Description of a New Species of the Genus Hydrargyra; with some additions to the Catalogue of the Fishes of Massachusetts in Professor Hitchcock's "Report," by Humphreys D. Storer 416
18. Remarks on the Positions assumed by George Ord, Esq., in relation to the Cow Black-Bird (Icterus Agripennis), in Loudon's Magazine for February, 1836, by Thomas M. Brewer 418
19. Some Additions to the Catalogue of the Birds of Massachusetts in Professor Hitchcock's "Report," by Thomas M. Brewer 435
20. Description of a New Species of the Genus Marginella (Lam.), with some Observations upon the same, by Captain Joseph P. Couthony . . . 440
21. An Anatomical Description of the Galapagos Tortoise, by J. B. S. Jackson, M.D. 443
22. Description of a New Species of the Genus Gasterosteus, by D. Humphreys Storer, M.D. 461
23. Description of a New Species of Marginella, by D. Humphreys Storer, M.D. 465
24. A Monograph of the Helices inhabiting the United States, by A. Binney, M.D. 466

Boston Journal of Natural History—*Continued.*

VOL. II.

ARTICLE
1. Descriptions of New Species of Coleopterous Insects inhabiting the State of Maine, by John W. Randall . . . 1
2. Descriptions of New Species of Coleopterous Insects inhabiting the State of Massachusetts, by John W. Randall . . . 34
3. Descriptions of New Species of Mollusca and Shells, and Remarks on several Polypi found in Massachusetts Bay, by Captain Joseph P. Couthony . . 53
4. Notice of three Species of Trillium found in the Vicinity of Boston, by Mr. J. E. Teschemacher . . . 112
5. Description of a New Species of Nucula from Massachusetts Bay, by D. Humphreys Storer, M.D. . . . 122
6. Observations on the Plumage of the Red and Mottled Owls (Strix Asio), by Mr. Samuel Cabot, jun. . . . 126
7. Monograph on the Family Osteodesmacea of Deshayes, with Remarks on two Species of Patelloidea, and Descriptions of New Species of Marine Shells, a Species of Anculotus, and one of Eolis, by Captain Joseph P. Couthony . . 129
8. Remarks on the North American Insects belonging to the Genus Cychrus of Fabricius; with Descriptions of some newly detected Species, by Thaddeus Wm. Harris, M.D. . . . 189
9. A Description of the Principal Fruits of Cuba, by the Rev. F. W. P. Greenwood. 204
10 An Enumeration of some Lichenes of New England, with Remarks, by Edward Tuckerman, jun. . . . 245
11. Observations on some Species of the Marine Shells of Massachusetts, with Descriptions of five New Species, by Professor C. B. Adams . . 262
12. A Report on the Fishes of Massachusetts, by D. Humphreys Storer . . 289

VOL. III.

1. A Report on the Reptiles of Massachusetts, by D. Humphreys Storer . 1
2. A Report on the Birds of Massachusetts, by the Rev. W. B. O. Peabody . 65
3. Descriptions of Four New Species of Fishes, by Jared P. Kirtland, M.D. . 273
4. Descriptions of Three New Species of Shell, by John G. Anthony . 278
5. Notice of Native Nitrate of Soda, containing Sulphate of Soda, Chloride of Sodium, Sodate of Soda, and Chloriodide of Sodium, by A. A. Hayes . 279
6. A further Enumeration of some New England Lichenes, by Edward Tuckerman 281
7. Notice of Minerals from New Holland, by Francis Alger . . 306
8. Descriptions of Eleven New Species of New England Shells, by C. B. Adams 318
9. Description of Tellina tenta, Say, and of Helix serpuloides, Montagu, with Remarks on other Marine Shells of Massachusetts, by C. B. Adams . . 332
10. Descriptions of the Fishes of the Ohio River and its Tributaries, by Jared P. Kirtland 338
11. A Monograph of the Helices inhabiting the United States, continued, by Amos Binney 353
12. Descriptions of Two New Species of Anculotus, by J. G. Anthony . 394
13. Monograph of the Species of Pupa found in the United States, with Figures, by Augustus A. Gould . . . 395
14. A Monograph of the Helices inhabiting the United States, continued, by Amos Binney 405
15. Further Notices of some New England Lichenes, by Edward Tuckerman . 438
16. Attempt to ascertain some of the Hepatic Mosses of Massachusetts, with Remarks, by John Lewis Russell . . . 465
17. Descriptions of the Fishes of the Ohio River and its Tributaries, by Jared P. Kirtland 469
18. Results of an Examination of the Shells of Massachusetts, and their Geographical Distribution, by Augustus A. Gould . . . 483

VOL. IV. PART 1. JANUARY, 1842.

1. Dissection of two adult Dromedaries, a Male and a Female, by J. B. S. Jackson, M.D. 1
2. Descriptions of the Fishes of the Ohio River and its Tributaries, by Jared P. Kirtland, M.D. (continued from vol. iii. 482). . . 16
3. Observations on the Genus Scalops (Shrew Moles), with Descriptions of the Species found in North America, by J. Bachman, D.D. . . 26
4. On the Occurrence of the Phosphate of Uranum in the Tourmaline locality at Chesterfield, by T. E. Teschemacher . . 35
5. Descriptions of Twenty-four Species of the Shells of New England, by J. W. Mighels, M.D., and Professor C. B. Adams . . 37
6. Descriptions and Figures of the Araneides of the United States, by N. M. Hentz 54

Boston Journal of Natural History—*Continued.*

ARTICLE
7. Description of Two New Species of Fishes, by D. Humphreys Storer, M.D. . 58
8. On a New Species of Raffleria, from Manilla, by J. E. Teschemacher . . 63
9. Remarks upon Coral Formations in the Pacific; with suggestions as to the Causes of their Absence in the same Parallels of Latitude on the coast of South America, by Joseph P. Couthony 66
10. Niagara Falls, their physical Changes, and the Geology and Topography of the surrounding Country, by James Hall 106
11. Note to the Editors, respecting the Fossil Bones from Oregon, by Henry C. Perkins, M.D. 134
12. Remarks upon Coral Formations in the Pacific, by J. P. Couthony (continued from page 105). 137

VOL. IV. PART 2. SEPTEMBER, 1842.

13. Descriptions of some of the Species of naked, air-breathing Mollusca inhabiting the United States, by Amos Binney . . 163
14. Additional descriptions of, and observations on, the Fishes of Massachusetts, by D. Humphreys Storer, M.D. 175
15. An Inquiry into the Distinctive Characteristics of the Aboriginal Race of America, by Samuel G. Morton, M.D. 190
16. Descriptions and Figures of the Araneides of the United States, by N. M. Hentz (continued from p. 57). 223
17. Descriptions of the Fishes of Lake Erie, the Ohio River, and their Tributaries, by J. P. Kirtland, M.D. (continued from page 26) . . . 231
18. Descriptions of a Species of Helix, newly observed in the United States, by Amos Binney, M.D. . . . 241
19. Observations on the Habits of the Python Natalensis, by T Savage, M.D. . 242
20. Observations on the Characters and Habits of the ocellated Turkey (Meleagris ocellata, Cuv.), by Samuel Cabot, M.D. . . . 246
21. On the Existence of Silicious (?) Speculæ in the exterior Rays of Actinia: and Memoranda concerning the Silicious Animalcules of Boston, by Professor J. W. Bailey 252
22. Enumeration of the Fishes of Brookhaven, L. Island, with remarks on the Species observed, by William O. Ayres 255
23. Enumeration of the Fishes of Brookhaven, by William O. Ayres (continued from p. 264) 265

VOL. IV. PART 3. APRIL, 1843.

24. Descriptions of four Species of Fishes from Brookhaven, L. I., all of which are believed to be new, by Wm. O. Ayres . . . 293
25. Descriptions of the Fishes of the Ohio River and its Tributaries, by Jared P. Kirtland, M.D. (continued from page 240) . . . 303
26. Catalogue of the Marine, Fluviatile, and Terrestrial Shells of the State of Maine and adjacent Ocean, by J. W. Mighels, M.D. . . . 308
27. Descriptions of Six Species of Shells regarded as new, by J. W. Mighels, M.D. 345
28. Monograph of the Species of Pupa found in the United States, with Figures, by Augustus A. Gould, M.D. (continued from vol. iii. 404) . . 350
29. Descriptions of two undescribed Species of North American Helices, by Amos Binney 360
30. Observations on the external Characters and Habits of the Troglodytes Niger, Geof., by Thomas S. Savage; and on its Organization, by Jeffries Wyman, M.D. 362
31. Descriptions and Figures of the Araneides of the United States, by N. M. Hentz (continued from page 231) 376

VOL. IV. PART 4. JANUARY, 1844.

32. Descriptions of an African Beetle, allied to Scarabæus Polyphemus, with Remarks upon some other Insects of the same Group, by T. W. Harris, M.D. . 397
33. On the Importance of Habit as a guide to accuracy in Systematical Arrangement, illustrated in the instance of the Sylvia petechia of Wilson, and all subsequent writers, by Thomas Mc Cullock, jun. . . . 406
34. On the Anatomy of Tebennophorus Carolinensis, by Jeffries Wyman, M.D. 410
35. On the Anatomical Structure of Glandina Truncata of Say, by J. Wayman . 416
36. Beaumontite and Lincolnite identical with Henlandite, by Francis Alger 422
37. Probable Influence of Icebergs upon Drift, by J. L. Hayes . . . 426
38. Descriptions of Land Shells from the province of Savoy, in British Burmah, by Augustus A. Gould, M.D. 452
39. Descriptions and Habits of some of the Birds of Yucatan, by S. Cabot . 460
40. Enumeration of the recent Fresh-water Mollusca which are common to North

Boston Journal of Natural History—*Continued.*

ARTICLE
America and Europe; with observations on Species, and their distribution, by S. S. Haldeman 468
41. Descriptions and Notices of some of the Land Shells of Cuba, by Augustus A. Gould, M.D. 485
42. Mineralogical Notices, by J. E. Teschemacher 498
43. Analysis of Pink Scapolite and of Cerium Ochre, from Bolton, Massachusetts, by Charles T. Jackson 504

VOL. V. PART 1. JANUARY, 1845.

1. Nature of the Strata, and Geographical Distribution of the Organic Remains, in the Older Formations of the United States, by James Hall 1
2. Descriptions of the Fishes of the Ohio River and its Tributaries, by Jared P. Kirtland, M.D (continued from vol. iv. page 308) 21
3. A Monography of the North American Histeroides, by John Le Conte . . . 32
4. On the Occurrence of Uranium in the Beryl locality at Ackworth, N. H., by J. E. Teschemacher 87
5. Description of a New Species of Salamander, by Lewis R. Gibbs, Professor of Mathematics and Chemistry in the College of Charleston, South Carolina . . 89
6. Further Accounts of some of the Birds of Yucatan, by Samuel Cabot, jun. M.D. 90
7. A further Enumeration of some Alpine and other Lichenes of New England, by Edward Tuckerman, A.M. 93
8. Character of some New Genera and Species of Plants of the natural Order Compositæ, from the Rocky Mountains and Upper California, by Asa Gray, M.D. 104
9. Descriptions of Six North American Carices, by Francis Boott, M.D., F.R. and L.S., Corresponding Member of the Society 112
10. An attempt to prove that Cottus coquatus of Richardson, Cottus viscosus of Haldeman, and Uranidea quiescens of De Kay, are one Species, and are identical with Cottus gobio of Linnæus, by W. O. Ayres, East Hartford, Ct. . . 116

VOL. V. PART 2. OCTOBER, 1845.

11. Dissection of a Spermaceti Whale, and three other Cetaceans, by J. B. S. Jackson, M.D. 137
12. Musci of Eastern Massachusetts, by John Lewis Russell, A.A.S. . . 172
13. Descriptions and Figures of the Araneides of the United States, by Nicholas Marcellus Hentz, Tuscaloosa, Alabama (continued from vol. iv. page 396) . . 189
14. Descriptions of some New and Interesting Insects inhabiting the United States, by John L. Le Conte 203
15. Plantæ Lindheimerianæ; an Enumeration of the Plants collected in Texas, and distributed to Subscribers, by F. Lindheimer; with Remarks and Descriptions of New Species, &c., by George Engelmann and Asa Gray 210
16. Descriptions of the Fishes of Lake Erie, the Ohio River, and their Tributaries, by Jared P. Kirtland, M.D. (continued from page 32) . . . 265
17. Illustrations of Fossil Footmarks, by James Deane, M.D. . . . 277
18. Descriptions of some New Species of Marine Shells, inhabiting the Coast of the United States, by Henry C. Lea, Philadelphia 285
19. Descriptions of Shells from the Coast of Africa, by Augustus A. Gould, M.D. 290
20. Note on Melocactus viridescens, Nutt. (Echinocactus, Torr. and Gr.), by J. E. Teschemacher 293
21. Notice of Two Species of Linguatula, by Jeffries Wyman, M.D. . . . 294

VOL. V. PART 3. JUNE, 1846.

22. Notices of New Localities of rare Minerals, and Reasons for uniting several supposed distinct Species, by Francis Alger 297
23. An Account of two remarkable Trains of Angular Erratic Blocks, in Berkshire, Mass., with an attempt at an Explanation of the Phenomena, by Professor Henry D. Rogers and Professor William B. Rogers 310
24. Descriptions of the Fishes of Lake Erie, the Ohio River, and their Tributaries, by Jared P. Kirtland, M.D. (concluded from page 276) . . . 330
25. Anatomical Description of the Animal of Littorina angulifera, Lam., by Joseph Leidy, M.D. 344
26. Notice of a new Genus of Plants of the order Santalaceæ, by Asa Gray . . 348
27. Descriptions and Figures of the Araneides of the United States, by Nicholas Marcellus Hentz, Tuscaloosa, Alabama 352
28. On the Fossil Vegetation of America, by J. E. Teschemacher . . . 370
29. Notice of the Geological Position of the Cranium of the Casteroides Ohioensis, by James Hall, Esq., one of the New York State Geologists; also, An Anatomical Description of the same, by Jeffries Wyman, M.D., Professor of Anat. and Phys. in Med. Dep. of Hampden and Sydney College 385

Boston Journal of Natural History—*Continued.*

ARTICLE
30. Polythalamia in sand from the Sahara Desert, by John Bacon, jun. M.D. . 402
31. Chemical and Mineralogical Fragments, by C. T. Jackson, M.D. . 405
32. On the Habits of Salmo Fontinalis, from a letter addressed to Dr. Storer, by J. B. Forsyth, M.D. 412
33. Description of Pyranga roseo-gularis (rose-throated Tanager), by Samuel Cabot, jun., M.D. 415

VOL. V. PART 4. DECEMBER, 1847.

34. Notice of the External Characters and Habits of Troglodytes Gorilla, a New Species of Orang from the Gaboon River, by Thomas S. Savage, M.D., Corresponding Member, Boston Society Natural History. Osteology of the same, by Jeffries Wyman, M.D., Hersey Professor of Anatomy in Harvard University. . 417
35. Descriptions and Figures of the Araneides of the United States, by Nicholas Marcellus Hentz, Tuscaloosa, Alabama (continued from page 370) . . 443
36. Dissection of Scymnus brevipenna, Lesueur, by S. Kneeland, jun., M.D. . 479
37. Description and Analysis of three Minerals from Lake Superior, by J. D. Whitney 486
38. The Dodo (Didus ineptus), a Rasorial and not a Rapacious Bird, by Samuel Cabot, M.D. 490

VOL. VI. PART 1. OCTOBER, 1848.

1. On the Embryology of Nemertes, with an Appendix on the Embryonic Development of Polynæ; and Remarks upon the Embryology of Marine Worms in general, by E. Desor, Boston 1
2. Descriptions and Figures of the Araneides of the United States, by Nicholas Marcellus Hentz, Tuscaloosa, Alabama 18
3. Chemical Examination of some American Minerals, by J. D. Whitney, Boston 36
4. Examination of three New Mineralogical Species proposed by Professor C. U. Shepard, by J. D. Whitney 42
5. Observations on some of the Habits of Salmo Fontinalis, by Samuel S. Bigelow, M. D., Worcester 49
6. Description of a New Genus of Fishes (Malacosteus), by W. O. Ayres, Boston 53
7. On the Pselaphidæ of the United States, by John L. Le Conte, M.D., New York 64
8. Dissection of Crocodilus Lucius, by Samuel Kneeland, jun., M.D., Boston . 110
9. Chemical Examination of Algerite, a New Mineral Species, by T. S. Hunt, of the Geological Commission of Canada, including a Description of the Mineral, by F. Alger, Boston 118
10. Examination of a Mineral from Cherokee County, Georgia, by Francis Alger, Boston 123
11. On the Cancellated Structure of some of the Bones of the Human Body, by Jeffries Wyman, M.D., Cambridge 125

VOL. VI. PART 2. JANUARY, 1850.

12. Planta Lindheimerianæ, Part II. An account of a Collection of Plants made by F. Lindheimer, in the west part of Texas, in the years, 1845, 1846, and 1847, 1848, with Critical Remarks, Descriptions of New Species &c., by Asa Gray, M.D. 142
13. Description of a New Species of Polypterus from West Africa, by W. O. Ayres, Boston, Massachusetts 241
14. Observations on the Fishes of Nova Scotia and Labrador, with Descriptions of New Species, by Horatio Robinson Storer 277

VOL. VI. PART 3. APRIL, 1852.

15. A few Ornithological Facts gathered in a hasty trip through portions of New Brunswick and Nova Scotia, in June, 1850, by T. M. Brewer, M.D. . 297
16. Notice of the Egg of Thalassidroma Leachii, with Descriptions of the Eggs of Procellaria Bulwerii, Precellaria obscura, and Puffinus Major. Read before the Boston Society of Natural History, by T. M. Brewer, M.D. . . 308
17. Description of five New Species of Birds, and other Ornithological Notes of Cuban Species. Read before the Boston Society of Natural History, March 3, 1852, by John Gundlach 313
18. The Organic Relations of some of the Infusoria, including Investigations concerning the Structure and Nature of the Genus Bodo (Ehr.). Read before the Boston Society of Natural History, November 5, 1851, by W. J. Burnett, M.D. 319
19. Notes and Observations on the Analysis and Character of the Soils of the Scioto Valley, Ohio, with some general Considerations respecting the subject of Soil

Boston Journal of Natural History—*Continued.*

ARTICLE
Analyses. Read before the Boston Society of Natural History, March 3, 1852, by David A. Wells 324
20. Description (with Figure) of Menobranchus punctatus, by Lewis R. Gibbes, M.D., Professor Math., College, Charleston, S. C. 369
21. Descriptions of Shells from the Gulf of California and the Pacific Coasts of Mexico and California, by Augustus A. Gould, M.D. 374

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CONTENTS.

Introduction.
Description of Six New Species of the Genus Firola, observed by Messrs. Le Sueur and Péron, in the Mediterranean Sea, in the months of March and April, 1809, by C. A. Le Sueur.
Account of an American Quadruped supposed to belong to the Genus Ovis, by G. Ord.
Description of Seven Species of American Fresh-water and Land Shells, not noticed in the Systems, by Thomas Say.
The same, concluded.
Description of several New Species of North-American Insects, by Thomas Say.
Observations on the Genus Eriogonum and the natural Order Polygoneæ of Jussieu, by Thomas Nuttall.
Notice of the late Doctor Waterhouse.

Journal of the Academy of Natural Sciences of Philadelphia—*Continued.*

Observations on the Genus Eriogonum, &c., concluded.
Character of a New Genus, and Descriptions of three New Species upon which it is formed; discovered in the Atlantic Ocean, in the months of March and April, 1816, lat. 22° 9′, by C. A. Le Sueur.
Description of three New Species of the Genus Raja, by C. A. Le Sueur.
Some Account of the Insect known by the name of Hessian Fly, and of a parasitic Insect that feeds on it, by Thomas Say.
On a New Genus of the Crustacea, and the Species in which it is established, by Thomas Say.
An Account of an American Species of the Genus Tantalus, or Ibis, by George Ord.
An Account of the Crustacea of the United States, by Thomas Say.
An Account of the Crustacea of the United States, continued.
A short Description of five (supposed) New Species of the Genus Muræna, discovered by Mr. Le Sueur, in the year 1816, by C. A. Le Sueur.
Description of two New Species of the Genus Gadus, by the same.
Description of a New Species of the Genus Cyprinus, by the same.
An Account of an American Species of Tortoise, not noticed in the Systems, by the same.
A New Genus of Fishes, of the Order Abdominales, proposed under the name Catostomus, and the characters of this Genus, with those of its Species, indicated, by the same.
An Account of the Crustacea of the United States (continued).
Catostomus, a New Genus of Fishes (concluded).
An Account of two New Genera of Plants, and of a Species of Tillæa, and another of Limosella, recently discovered on the banks of the Delaware, in the vicinity of Philadelphia, by Thos. Nuttall.
Descriptions of New Species of Land and Fresh-water Shells of the United States, by Thomas Say.
Descriptions of four New Species, and two Varieties, of the Genus Hydrargira, by C. A. Le Sueur.
Observations on the Geology of the West India Islands, from Barbadoes to Santa Cruz, inclusive, by William Maclure.
Observations on several Species of the Genus Actinia; illustrated by Figures, by C. A. Le Sueur.
An Account of the Crustacea of the United States (continued).
Observations on several Species of the Genus Actinia (continued.)
Description of Collinsia, a New Genus of Plants, by Thomas Nuttall.
Act of Incorporation.
Constitution.
Catalogue of the Library.
List of Donors to the Library.
List of Donations to the Museum.
List of Donations to the Apparatus.

Vol. I. Part II. 11 Plates. 8vo, pp. 221 to 503. Philadelphia, 1818.

CONTENTS.

Officers of the Academy of Natural Sciences for the year 1818.
Descriptions of several New Species of North American Fishes, by C. A. Le Sueur.
An Account of the Crustacea of the United States, by Thomas Say (continued).
Observations on two Species of the Genus Gracula of Latham, by George Ord.
Report of a Committee on a New Hydrostatic Balance, invented by Isaiah Lukens, and submitted to the Academy.
Essay on the Formation of Rocks; or, an Inquiry into the Probable Origin of their present Form and Structure, by William Maclure (continued).
Account of two New Genera and several New Species of Fresh-water and Land Shells, by Thomas Say.
Essay on the Formation of Rocks; or, an Inquiry into the Probable Origin of their present Form and Structure, by William Maclure (continued).
Observations of a New Genus of Fossil Shells, by C. A. Le Sueur.
An Account of the Crustacea of the United States, by Thomas Say (continued).
Observations on the Genus Glicine and some of its kindred Genera, by S. Elliott.
Essay on the Formation of Rocks; or, an Inquiry into the Probable Origin of their present Form and Structure, by William Maclure (concluded).
An Account of the Florida Jay of Bartram, by George Ord.
Description of several Species of North American Amphibia, accompanied with Observations, by Jacob Green.
Description of several New Species of North American Fishes, by C. A. Le Sueur (continued).

Journal of the Academy of Natural Sciences of Philadelphia—*Continued.*

Description of a Hydrostatic Balance, by which the Specific Gravity of Minerals may be ascertained without calculation, by Benjamin H. Coates, M.D.
Observations on the Genus Glycine, and some of its kindred Genera, by Stephen Elliott (concluded).
An Account of the Crustacea of the United States, by Thomas Say (continued).
A Case of an unusual Arrangement in the ascending Cava and in the external Jugular Veins of the Human Subject, by William E. Horner, M.D.
Notes on Professor Green's Paper on the Amphibia, published in the September number of this Journal, by Thomas Say.
Description of three Species of Fish, by Samuel L. Mitchill, M.D.
Description of several New Species of the Genus Essox of North America, by C. A. Le Sueur.
Description of three New Genera of Fluviatile Fish, Pomoxis, Sarchirus, and Exoglossum, by C. S. Rafinesque.
An Account of the Crustacea of the United States, by Thomas Say (concluded).
Observations on some of the Animals described in the Account of the Crustacea of the United States, by the same.
Appendix to the Account of the Crustacea of the U. S., by the same.
Description of a New Genus of Fresh-water Bivalve Shells, by the same.
Description of New Species of Linnæan Lacerta, by Jacob Gilliams.
An Account of Minerals at present known to exist in the vicinity of Philadelphia, by Isaac Lea.
Description of three Species of the Genus Næsa, by Thomas Say.
Remarks of the Publishing Committee.
Alphabetical Index, Zoological and Botanical.
Catalogue of the Library (continued).
List of Donors to the Library.
List of Donations to the Museum.
List of Donations to the Apparatus.
Reference to the Plates of vol. i.

Vol. II. Part I. 14 Plates. 8vo, pp. iv., 192, and xv. Philadelphia, 1821.

CONTENTS.

Officers of the Academy of Natural Sciences, for the year 1821.
Description of a New Genus and several New Species of Fresh-water Fish, indigenous to the United States, by C. A. Le Sueur.
Description of two New Species of Exocetus, by C. A. Le Sueur.
Descriptions of the Thysanouræ of the United States, by Thomas Say.
Observations on the Geological Structure of the Valley of Mississippi, by Thomas Nuttall.
Notice concerning a New Species of American Spider, whose web is used in Medicine, by N. M. Hentz.
Description of some New Crystalline Forms of Phosphate of Lime and Zircon, by Dr. G. Troost.
Descriptions of the Arachnides of the United States, by Thomas Say.
Analysis of the Blue Iron Earth of New Jersey, by Lardner Vanuxem.
Descriptions of several New Species of Cuttle-fish, by C. A. Le Sueur.
Descriptions of the Myriapodæ of the United States, by Thomas Say.
Descriptions of some New Species of Plants recently introduced into the Gardens of Philadelphia, from the Arkansa Territory, by Thomas Nuttall.
Observations on several Genera and Species of Fish belonging to the Natural Family of the Esoces, by C. A. Le Sueur.
Analysis of some American Minerals, by Henry Seybert.
On two Veins of Pyroxene or Augite in Granite, by Lardner Vanuxem.
Description of Univalve Shells of the United States, by Thomas Say.
Description of rare Plants recently introduced into the Gardens of Philadelphia, by Thomas Nuttall.
Description and Analysis of the Table-Spar, from the vicinity of Willsborough, Lake Champlain, by Lardner Vanuxem.
Geological and Mineralogical Notice of a portion of the North-Eastern part of the State of New York, by Augustus E. Jessup.
Note by Publishing Committee.

Vol. II. Part II. pp. 193 to 408. 5 Plates, 1 Map. Philadelphia, 1822.

CONTENTS.

Officers of the Academy of Natural Sciences for the year 1822.
Description and Analysis of the Jeffersonite, a new Mineral, by W. H. Keating.

Journal of the Academy of Natural Sciences of Philadelphia—*Continued.*

On the Gales experienced in the Atlantic States of North America, by R. Hare, M.D.
Description of a New Crystalline Form of Quartz, by G. Troost, M.D.
Description of five New Species of Genus Cichla, by C. A. Le Sueur.
Account of some of the Marine Shells of the United States, by Thomas Say.
On a New Locality of the Automalite, by Lardner Vanuxem.
Description of three New Species of the Genus Sciæna, by C. A. Le Sueur.
Account of some of the Marine Shells of the United States, by Thomas Say (continued).
On the Geology and Mineralogy of Franklin, in Sussex County, New Jersey, by Lardner Vanuxem and W. H. Keating.
Observations upon the Cadmia found at the Ancram Iron Works, Columbia County, New York, by W. H. Keating.
On the Onykia Angulata, by C. A. Le Sueur.
Description of some Crystals of Sulphate of Strontian from Lake Erie, by G. Troost, M.D.
Account of some of the Marine Shells of the United States, by Thomas Say (concluded).
Geological Sketches of the Mississippi Valley, by Edwin James, M.D.
Description of a Quadruped belonging to the order Rodentia, by Thomas Say.
Description of a Squalus of very large size, which was taken on the Coast of New Jersey, by C. A. Le Sueur.
On a South American Species of Œstrus, which inhabits the Human Body, by T. Say.
On two remarkable Hepatic Mosses found in North Carolina, by L. D. Schweinitz.
Description of Univalve Terrestrial and Fluviatile Shells of the United States, by Thomas Say.
Note.
Catalogue of the Library (continued).
List of Donors to the Library.
List of Donations to the Museum with the Donors' names.
Alphabetical Index to Volume II.
List of Plates.
Errata.

Vol. III. Part I. 7 Plates. 8vo, pp. iv. and 224. Philadelphia, 1823.

CONTENTS.

Officers of the Academy of Natural Sciences for the year 1823.
Descriptions of several New Species of Ascidia, by C. A. Le Sueur.
Descriptions of Dipterous Insects of the United States, by Thomas Say.
Dissection of a Batrachian Animal in a living state, by R. Harlan, M.D.
Description and Analysis of the Zirconite of Buncombe Co., North Carolina, by Lardner Vanuxem.
Observations on Fossil Elephant Teeth of North America, by R. Harlan, M.D.
Description and Analysis of a Lamellar Pyroxene, by Lardner Vanuxem.
Descriptions of Dipterous Insects of the United States, by Thomas Say (continued).
Account of the Pyroxene of the United States, and Descriptions of some New Varieties of its Crystalline Forms, by G. Troost, M.D.
Observations on the Genus Oryzopsis, by Thomas Nuttall.
On the Marmolite of Mr. Nuttall, by Lardner Vanuxem.
Remarks on the Species of Corallorhiza indigenous to the United States, by Thomas Nuttall.
Description of Coleopterous Insects, by Thomas Say.
An Account of the Insect so destructive to the Peach Tree, by James Worth.
Notice of the Yenite of Rhode Island, and several other American Minerals, by G. Troost, M.D.

Vol. III. Part II. 6 Plates. 8vo, pp. iv. and 225 to 410. Philadelphia, 1824.

CONTENTS.

Officers of the Academy of Natural Sciences of Philadelphia, for the year 1824.
Publishing Committee of the Academy.
An Account of four Species of Stormy Petrels, by Charles Bonaparte.
Description of the American Petalite from Lake Ontario, by G. Troost, M.D.
Descriptions of Coleopterous Insects, by Thomas Say (continued).
Description of a New Species of the Genus Loligo, by C. A. Le Sueur.
Notices of American Spodumen.
On three New Species of Parasitic Vermes belonging to the Linnæan Genus Lernæa, by C. A. Le Sueur.
Description of a Crystalline Form of Chrysoberyl, by G. Troost, M.D.

Journal of the Academy of Natural Sciences of Philadelphia—*Continued.*

Analysis of an Ore of Copper from New Jersey, by George T. Bowen.
Description of Coleopterous Insects, by Thomas Say (continued).
On a Fossil Genus of the Order Enalio Sauri (Conybeare), by R. Harlan, M.D.
On a New Extinct Fossil Species of the Genus Ichthyosaurus, by R. Harlan, M.D.
Observations on the Nomenclature of Wilson's Ornithology, by C. Bonaparte.
Account of an Examination of Fused Charcoal, by Lardner Vanuxem.
Descriptions and Analysis of the Sillimanite, a New Mineral, by George T. Bowen.
On a New Species of Duck, described by Wilson as the same with the Anas Fuligula of Europe, by Charles Bonaparte.
On a Species of Lamantin resembling the Menatus Senegalensis (Cuvier), inhabiting the Coast of East Florida, by R. Harlan, M.D.
Descriptions of two New Species of the Genus Batrachoid of Lacepede, by C. A. Le Sueur.
Descriptions of Coleopterous Insects, by Thomas Say (continued.)
Catalogue of the Library (continued).
List of Donors to the Library.
List of Donations to the Museum with the Donors' names.
Alphabetical Index to Volume III.
List of Plates.
Addenda et Corrigenda.

Vol. IV. Part I. 13 Plates. 8vo, pp. iv. and 200. Philadelphia, 1824.

CONTENTS.

List of Officers.
Observations upon some of the Minerals discovered at Franklin, Sussex County, N. J., by Lardner Vanuxem and W. H. Keating.
Nova Generis Capromys, Desm. Species, auctore Edwardo Pœppig, M.D. Lips. Sax.
On an extinct Species of Crocodile not before described; and some Observations on the Geology of West Jersey, by R. Harlan, M.D.
Observations on the Nomenclature of Wilson's Ornithology, by Charles Bonaparte (continued).
Description of the Os Hyoides of Mastodon, by John D. Godman, M.D.
Description of a Testaceous Formation at Anastasia Island, extracted from Notes made on a Journey to the Southern Parts of the United States, during the Winter of 1822 and 1823, by R. Dietz.
Description of a New Species of Fish, of the Linnæan Genus Perca, by J. Gilliams.
Descriptions of Colepterous Insects collected in the late Expedition to the Rocky Mountains, by Thomas Say.
Description of several Species of the Linnæan Genus Raia, of North America, by C. A. Le Sueur.
Description of a New Crystalline Form of the Andalusite, by G. Troost, M.D.
An Account of some of the Fossil Shells of Maryland, by Thomas Say.
Description of several New Species of Holothuria by C. A. Le Sueur.
Observations on the Nomenclature of Wilson's Ornithology, by Charles Bonaparte (continued).

Vol. IV. Part II. 10 Plates. 8vo, pp. iv. 203 to 411. Philadelphia, 1825.

CONTENTS.

Officers of the Academy of Natural Sciences of Philadelphia, for the year 1825.
On the Fresh-water and Land Tortoises of the United States, by Thomas Say.
Observations on the Zinc Ores of Franklin and Sterling, Sussex County, New Jersey, by G. Troost, M.D.
Notice of the Plesiosaurus, and other Fossil Reliquiæ, from the State of New Jersey, by R. Harlan, M.D.
Description of three New Species of Coluber, inhabiting the United States, by T. Say.
Description of two Species of Linnæan Lacerta, not before described, and Construction of the New Genus Cyclura, by R. Harlan, M.D.
Observations on the Nomenclature of Wilson's Ornithology, by Charles Bonaparte (continued.)
Description of four New Species of Linnæan Genus Blennius and a New Exocetus, by William W. Wood.
Description of a New Species of Biped Seps, by R. Harlan, M.D.
Description of a New Species of Scincus, by R. Harlan, M.D.
On two Genera and several Species of Crinoidea, by Thomas Say.
Description of two New Species of Agama, by R. Harlan, M.D.
An Account of a New Species of the Genus Arvicola, by George Ord.
Description of a New Species of Salamander, by William W. Wood.

Journal of the Academy of Natural Sciences of Philadelphia—*Continued.*

Descriptions of New Hemipterous Insects, collected in the Expedition to the Rocky Mountains, performed by order of Mr. Calhoun, Secretary of War, under command of Major Long, by Thomas Say.
A New Genus of Mammalia proposed, and a Description of a Species upon which it is founded, by T. Say and G. Ord.
Description of a New Species of South American Fringilla, by Charles Bonaparte.
Description of a New Species of Mammalia, whereon a Genus is proposed to be founded, by T. Say and G. Ord.
Remarks on the Floating Apparatus, and other peculiarities, of the Genus Ianthina, by Reynell Coates, M.D.
Description of two New Species of the Linnæan Genus Blennius, by C. A. Le Sueur.
Description of a New Species of Trilobite, by J. J. Bigsby, M.D.
On a New Species of Modiola, by Thomas Say.
Descriptions of ten Species of South American Birds, by Charles Bonaparte.
Description of two New Species of Mexican Birds, by Charles Bonaparte.
Catalogue of the Library (continued).
List of Donors to the Library.
List of Donations to the Museum, with Donors' names.
Alphabetical Index.
Plates of Volume IV.
Addenda and Corrigenda.

Vol. V. Part I. 8 Plates. 8vo, pp. iv. and 204. Philadelphia, 1825.

CONTENTS.

Officers of the Academy of Natural Sciences of Philadelphia, for the year 1825.
Description of a number of New American Species of Shapæriæ, by Lewis D. de Schweinitz.
Experiments on Anthracite, Plumbago, &c., by Lardner Vanuxem.
Additions to the Ornithology of the United States, by Charles Bonaparte.
Description of New Species of Hister and Hololepta, inhabiting the United States, by Thomas Say.
Description of a New Fish of the Genus Almo, by C. A. Le Sueur.
Description of a New Crystalline form of Apophyllite, Laumonite, and Amphibole, and of a variety of Pearlstone, by Gerard Troost, M.D.
Observations on the Nomenclature of Wilson's Ornithology, by Charles Bonaparte (continued).
Description of a New Species of Murænophis, by C. A. Le Sueur.
Note of the Genus Condylura of Illiger, by J. D. Godman, M.D.
Description of a New Species of Salamander, by Jacob Green.
Description of a New Species of the Genus Saurus (Cuvier,) by C. A. Le Sueur.
Descriptions of some New Species of Fresh-water and Land Shells of the United States, by Thomas Say.
Description of two Genera of the natural Order Cruciferæ, by Thomas Nuttall. Note, by J. D. Godman, M.D.
Description of a New Species of Salamandra, by R. Harlan, M.D.
Notes to the Paper entitled "Descriptions of ten Species of South American Birds," by Charles Bonaparte.
On the Species of the Linnæan Genus Asterias, inhabiting the Coast of the United States, by Thomas Say.
Description of a variety of the Coluber Fulvius (Linn.), a new Species of Scincus, and two New Species of Salamandra, by R. Harlan, M.D.
Observations on a Species of Anemone, of the Section Pulsatilla, indigenous to the United States, by Thomas Nuttall.
Descriptions of New Species of Coleopterous Insects inhabiting the United States, by Thomas Say.

Vol. V. Part II. 5 Plates. 8vo, pp. 205 to 410. Philadelphia, 1827.

CONTENTS.

Officers of the Academy of Natural Sciences of Philadelphia, for the year 1827.
Descriptions of Marine Shells recently discovered on the Coast of the United States, by Thomas Say.
Note on a Species of Scincus, by R. Harlan, M.D.
On the Distinction of two Species of Icterus, hitherto confounded under the specific name of Icterocephalus, by Charles Bonaparte.
On the Species of the Linnæan Genus Echinus, inhabiting the Coast of the United States, by T. Say.
Description of an Hermaphrodite Orang Outang, lately living in Philadelphia, by R. Harlan, M.D.

Journal of the Academy of Natural Sciences of Philadelphia—*Continued.*

Descriptions of New Species of Coleopterous Insects, inhabiting the United States, by T. Say (continued)
Description of a Land Tortoise from the Gallapagos Islands, commonly known as the "Elephant Tortoise," by R. Harlan, M.D.
Descriptions of New Species of Coleopterous Insects inhabiting the United States, by T. Say (concluded).
Genera of North American Reptilia, and a Synopsis of the Species, by R. Harlan, M.D.
Description of some New Species of North American Insects, by N. M. Hentz.
Remarks on the Limestones of the Mississippi Lead Mines, by E. James, M.D.
Descriptions of three Species of the Genus Cremastocheilus, by T. W. Harris, M.D., of Milton, Mass.
List of Donations to the Cabinet.
Alphabetical Index.
Plates of Vol. V.

Vol. VI. Part I. 7 Plates. 8vo, pp. iv. and 178. Philadelphia, 1827.

CONTENTS.

List of Officers for 1827.
Genera of North American Reptilia, and Synopsis of the Species, by R. Harlan, M.D. (continued).
Remarks on the Osmunda Claytoniana of Linnæus, by S. W. Conrad.
Analysis of Cyanite and Fibrolite, and their Union in one Species under the name of Disthene, by Lardner Vanuxem.
Analysis of Tabular Spar, from Bucks County, Penn., with a Notice of various Minerals from the same locality, by S. G. Morton, M.D.
Description of a new Fossil Species of Ostrea, by the same.
Description of a New Species of Grampus, inhabiting the Coast of New England, by R. Harlan, M.D.
Additional Observations on the North American Reptilia, by the same.
Notes of certain prepared Specimens of Quadrupeds in the possession of a gentleman lately returned to Philadelphia from his Travels in the United States and Territories, by R. Harlan, M.D.
List of Officers for 1828.
Geological Observations on the Secondary, Tertiary, and Alluvial Formations of the Atlantic Coast of the United States, arranged from the Notes of Lardner Vanuxem, by S. G. Morton, M.D.
Description of the Fossil Shells which characterize the Atlantic Secondary Formation of New Jersey and Delaware, by S. G. Morton, M.D.
Description of a New Species of Salamandra, by R. Harlan, M.D.
Notice of a Mineral which approaches to the Bildstein of Werner; with Remarks on the connection of Bildstein with Feldspar, by S. W. Conrad.
Description of a New Species of Juncus, by S. W. Conrad.
Description of two New Species of Shells of the Genera Scaphites and Crepidula; with some Observations on the Ferruginous Sand, Plastic Clay, and Upper Marine Formations of the United States, by S. G. Morton, M.D.
Note, containing a Notice of some Fossils recently discovered in New Jersey, by S. G. Morton, M.D.
Remarks on the Pedunculated Cirrhipedes; with Descriptions of two New Species of Otion, by Reynell Coates, M.D.
Note on the Geographical Distribution of the Anatifa Vitrea, by the same.
Note on the Specific Heat of the Atoms of Bodies, by Alex. Dallas Bache.
Notice of a New Species of Corallorhiza, by S. W. Conrad.
Note on the Anphiuma Means, by R. Harlan, M.D.
Description of New Dipterous Insects of the United States, by Thomas Say.

Vol. VI. Part II. 8 Plates. 8vo, pp. 181 to 326. Philadelphia, 1830.

CONTENTS.

Notice of the Fall of a Meteoric Stone, at Deal, in New Jersey, by Robert Vaux and Thomas M'Euen, M.D.
Descriptions of North American Dipterous Insects, by Thomas Say.
Additional Observations on the Geology and Organic Remains of New Jersey and Delaware, by S. G. Morton, M.D.
On the Geology and Organic Remains of a part of the Peninsula of Maryland, by Timothy A. Conrad.
Description of two New Species of the Linnæan Genus Lacerta, by T. R. Peale and J. Green, M.D.
Description of New North American Hemipterous Insects, by Thomas Say.

Journal of the Academy of Natural Sciences of Philadelphia—*Continued.*

Observations on the Electrical Properties of Caoutchouc, or Gum Elastic, &c., by W. R. Johnson.
Description of two New Species of Salamander, by Jacob Green, M.D.
Description of fifteen New Species of recent, and three of Fossil Shells, chiefly from the Coast of the U.S., by Timothy A. Conrad.
Description of the Fossil Bones of the Megalonyx, discovered in White Cave, Kentucky, by R. Harlan, M.D.
Description of an extinct Species of Fossil Vegetable, of the Family of Fucoides, by R. Harlan, M.D.
Notice of some Parasitic Worms, by S. G. Morton, M.D.
Description of new North American Hemipterous Insects, by Th. Say (continued).
Donations to the Cabinet of the Academy, during the years, 1827, 1828, 1829, and 1830.
Index to the Sixth Volume.

Vol. VII. Part I. 13 Plates. 8vo, pp. 182. Philadelphia, 1834.

CONTENTS.

List of Officers for the year 1834.
Catalogue of Plants collected chiefly in the Valley of the Rocky Mountains, near the Sources of the Columbia River, by Mr. N. B. Wyeth. Described by T. Nuttall.
Description of some of the rarer or little-known Plants indigenous to the United States, by T. Nuttall.
Observations on the Tertiary and more recent Formations of a portion of the Southern States, by T. A. Conrad.
Descriptions of New Tertiary Fossils from the Southern States, by T. A. Conrad.
Analysis of some of the Coals at Pennsylvania, by H. D. Rogers and A. D. Bache.
Description of a New Genus of Fresh-Water Shells, by T. A. Conrad.
Description of a New Species of Hinnita, by T. A. Conrad.

Vol. VII. Part II. 10 Plates. 8vo, pp. 183 to 414. Philadelphia, 1837.

CONTENTS.

List of Officers for the year 1837.
Description of twelve New Species of Birds, chiefly from the vicinity of the Columbia River, by John Kirk Townsend.
Description of a New Species of Hare found in South Carolina, by J. Bachman.
On the Fusing Point of Zinc, and a reference to the Relation between the Tenacity and the Fusibility of the Metals in general, by Walter R. Johnson, A.M., &c.
Description of Two New Species of Trilobites, by Jacob Green, M.D.
Description of New Marine Shells from Upper California. Collected by T. Nuttall, Esq., by T. A. Conrad.
Observations on the Effects of a remarkable Atmospheric Current of Storm, as witnessed on the day following its occurrence, by Walter R. Johnson, A.M., M.A. N.S.P.
Observations on the Different Species of Hares (Genus Lepus) inhabiting the U.S. and Canada, by J. Bachman, D.D., President of the Literary and Philosophical Society, Charleston, S. C.
Some Remarks on the Genus Sorex, with a Monograph of the North American Species, by John Bachman.
Additional Note on the Genus Lepus.
Description of a New Species of Wood-pecker, by James Trudeau, M.D.

Vol. VIII. Part I. 9 Plates. 8vo, pp. 171. Philadelphia, 1839.

CONTENTS.

Officers of the Academy of Natural Sciences of Philadelphia, for the year 1839.
Description of New North American Neuropterous Insects, and Observations on some already described, by (the late) Thomas Say.
Summary of Meteorological Observations for 1836; made in Fayette County, Tennessee, by M. Rhea.
Description of Five New Fossils, of the older Pliocene Formation of Maryland and North Carolina, by Wm. Wagner.
A few Facts in relation to the Identity of the Red and Mottled Owls, by Ezra Michener, M.D.
Description of several New Species of American Quadrupeds, by the Rev. J. Bachman, of Charleston, S. C.
List of Quadrupeds procured by Mr. Townsend, and sent to the Academy of Natural Sciences.
Additional remarks on the Genus Lepus, with corrections of a former Paper, and descriptions of other Species of Quadrupeds found in North America, by John Bachman.

Journal of the Academy of Natural Sciences of Philadelphia—*Continued.*

Additional Species to the List of Mr. Townsend's Quadrupeds.
Catalogue of the Crustacea brought by Thomas Nuttall and J. K. Townsend from the West Coast of North America and the Sandwich Islands, &c., by J. W. Randall.
Description of a New Species of Cypcelus, from the Columbia River, by J. K. Townsend.
Description of a New Species of Sylvia, from the Columbia River, by the same.
An Analysis of Marl from New Jersey, by S. S. Haldeman.
List of Birds inhabiting the region of the Rocky Mountains, the Territory of Oregon, and the North-West Coast of America, by J. K. Townsend.
Note of Sylvia Tolmœi, by the same.
Description of the White-winged Tanager (Pyranga leucoptera), by J. Trudeau.
Description of a Species of Land-Tortoise, from Africa, by Edward Hllaowell, M.D.

Vol. VIII. Part II. 10 Plates. 8vo, pp. 172 to 354. Philadelphia, 1842.

CONTENTS.

Officers of the Academy of Natural Sciences of Philadelphia, for the year 1842.
Some Observations on the Mechanical Structure of Coal, with evidences of the contemporaneous origin of its various kinds, by Walter R. Johnson, A.M.
Description of three New Species of Unio from the Rivers of the United States, by T. A. Conrad.
Examination and Analysis of Coal found in the Province of Arauco, Coast of Chili, thirty miles south of Bio Bio River, by Walter R. Johnson, A.M.
Description of a New American Species of the Genus Helix, by John S. Phillips.
Description of twenty-four New Species of Fossil Shells, chiefly from the Tertiary deposits of Calvert Cliffs, Maryland, by T. A. Conrad.
Some Remarks on the Ancient Peruvians, by S. G. Morton, M.D.
On the relation between the Coal of South Wales and that of some Pennsylvania Anthracides, by W. R. Johnson, A.M.
Description of five New Species of American Fresh-water Shells, by S. S. Haldeman.
Description of the Nest and Eggs of the Fulica Americana and Anas discors, by George C. Leib, M.D.
Remarks on the so-called Pigmy Race of the Valley of the Mississippi, by S. G. Morton, M.D.
Description of some New Species of Organic Remains of the Cretaceous group of the U. S., with a Tabular View of the Fossils hitherto discovered in this Formation, by the same.
Observations on the Silurian and Devonian Systems of the U. S., with Descriptions of new Organic Remains, by T. A. Conrad.
Descriptions of New Species of Organic Remains belonging to the Silurian, Devonian, and Carboniferous Systems of the U. S., by the same.
Descriptions of New Species of Quadrupeds inhabiting North America, by J. J. Audubon, Esq., and the Rev. John Bachman, D.D.
Description of a New Species of Chameleon from Western Africa, by E. Hallowell, M.D.
Description of two New Species of the Genus Perca, from the Susquehanna River, by S. S. Haldeman.
Description of a New Species of Cyclops and two Species of Tubifex, by S. S. Haldeman.
Description of two New Species of Fossil Scutellæ, from South Carolina, by Edmund Ravenel, M.D.
Description of a New Genus of Serpents from Western Africa, by E. Hallowell, M.D.
Meteorological Observations made at Philadelphia, during the year 1841, by William S. Zantzinger, M.D.

Journal of the Academy of Natural Sciences of Philadelphia. 4to. New Series.

Vol. I. (1847—1850.) Part I. December, 1847.

Article

1. On the Fossil Genus Basilosaurus, Harlan (Zeuglodon, Owen), with a Notice of Specimens from the Eocene Green Sand of South Carolina, by Robert W. Gibbes, M.D., of South Carolina.
2. Notice of the Discovery of a Cranium of the Zeuglodon (Basilosaurus), by M. Tuomey, State Geologist of South Carolina.
3. Observations on certain Fossil Bones from the Collection of the Academy of Natural Sciences of Philadelphia, by Richard Owen, Esq., F.R.S., Professor of Comparative Anatomy in the Royal College of Surgeons, London, &c. &c.
4. Description of a New Rapacious Bird in the Museum of the Academy of Natural Sciences of Philadelphia, by John Cassin.

Journal of the Academy of Natural Sciences of Philadelphia—*Continued.*

ARTICLE
5. Remarks on the Birds observed in Upper California, with Descriptions of New Species, by William Gambel.
6. I. History and Anatomy of the Hemipterous Genus Belostoma, by Joseph Leidy, M.D. II Miscellanea Zoologica, by Joseph Leidy, M.D.
7. Fragmenta Entomologica, auctore J. L. Le Conte, M.D.

PART II. AUGUST, 1848.

8. Descriptions of North American Coleoptera, chiefly in the Cabinet of J. L. Le Conte, M.D., with reference to described Species, by S. S. Haldeman.
9. Observations on the Eocene Formation, and Descriptions of one hundred and five New Fossils of that Period, from the vicinity of Vicksburg, Mississippi; with an Appendix, by T. A. Conrad.
10. Description of a New Buceros, and a Notice of the Buceros Elatus (Temm.), both of which are in the Collection of the Academy of Natural Sciences of Philadelphia, by John Cassin.
11. Descriptions of three New Species of the Genus Icterus (Briss.,) Specimens of which are in the Museum of the Academy of Natural Sciences of Philadelphia, by John Cassin.
12. Monograph of the Fossil Squalidæ of the U. S., by R. W. Gibbes, M.D.
13. Descriptions of Plants collected by William Gambel, M.D., in the Rocky Mountains and Upper California, by Thomas Nuttall.

PART III. AUGUST, 1849.

14 Monograph of Fossil Squalidæ of the United States, by R. W. Gibbes, M.D., of South Carolina.
15. Descriptions of New Fossil and Recent Shells of the U. S., by T. A. Conrad.
16. Notes on Shells, with Descriptions of New Genera and Species, by T. A. Conrad.
17. Remarks on the Birds of Upper California, with Descriptions of New Species, by William Gambel, M.D.
18. Additional Observations on a New Living Species of Hippopotamus, by Samuel G. Morton, M.D., Penn. and Edinburgh.
19. Descriptions of New Species of Birds of the Genera Vidua (Cuvier), Euplectes (Swainson), and Pyrenestes (Swainson), Specimens of which are in the Academy of Natural Sciences of Philadelphia, by John Cassin.
20. Cryptocephalinarum Boreali-Americæ Diagnoses cum Speciebus novis Musei lecontiani Auctore S. S. Haldeman.
21. Observations on the Reproductive Organs and on the Fœtus of the Delphinus Mesarnak, by C. D. Meigs, M.D.

PART IV. JANUARY, 1850.

22. Descriptions of New Fresh-water and Marine Shells, by T. A. Conrad.
23. Revision of the North American Tailed Batrachia, with Descriptions of New Genera and Species, by S. F. Baird, Carlisle, Pennsylvania.
24. Descriptions of New Species of the Genera Micrastur (G. R. Gray), Tanagra (Linn.), and Sycobius, (Vieill.), by John Cassin.
25. New Species of Myliobates from the Eocene of S. Carolina, with other Genera not heretofore observed in the U. S., by Robert W. Gibbes, M.D.
26. Descriptions of two Species of Distoma, with the partial History of one of them, by Joseph Leidy, M.D.
27. An attempt to classify the Longicorn Coleoptera of the part of America north of Mexico, by John L. Le Conte, M.D.

VOL. II. (1850—1854.) PART I. NOVEMBER, 1850.

1. An attempt to classify the Longicorn Coleoptera, of the part of America north of Mexico, by John L. Le Conte, M.D.
2. Descriptions of one New Cretaceous and seven New Eocene Fossils, by T. A. Conrad.
3. Descriptions of some American Annelida Ambranchia, by J. Leidy, M.D.
4. Descriptions of Owls presumed to be New Species, in the Collection of the Academy of Natural Sciences of Philadelphia, by John Cassin.
5. Description of a New Species of Mergulus Ray, from the Coast of California, by William Gambel, M.D.
6. Description of fifteen New Species of Crinoidea from the Sub-carboniferous Limestone of Iowa, collected during the U. S. Geological Survey of Iowa, Wisconsin, and Minnesota, in the years 1848, 1849, by David D. Owen, M.D., and B. F. Shumard, M.D.
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Journal of the Academy of Natural Sciences of Philadelphia—*Continued.*

PART II. JANUARY, 1852.

ARTICLE

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18. An attempt to classify the Longicorn Coleoptera of the part of America north of Mexico, by John L. Le Conte, M.D.
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PART III. JANUARY, 1853.

20. Description of a Fossil Saurian of the New Red Sandstone Formation of Pennsylvania, with some Account of that Formation, by Isaac Lee.
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VOL. III. PART I. MAY, 1855.

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Journal of the Academy of Natural Sciences of Philadelphia—*Continued.*

ARTICLE

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When a copy of the "Birds of America" was received by the Royal Academy of Sciences of Paris, Baron Cuvier, to whom it was referred, said, in his Report, "it can be described only by calling it the most magnificent monument Art has ever raised to Ornithology."

John James Audubon was born of French parents near New Orleans, in 1780. At a very early age he was sent to France, and educated in Art and Science under the best masters, among whom was David. The love of birds, which has been the passion of his life, manifested itself in infancy, and when he returned from France, he betook himself to his native woods, and began a collection of drawings, which made the germ of the "Birds of America." In 1824, Lucien Buonaparte proposed to buy his drawings; he resolved however to publish them himself, and as it could not be done in America, went to England. The drawings were first exhibited at Edinburgh, and encouraged by men like Herschel, Cuvier, Humboldt, and Scott, Worcester, Wilson, and Jeffery, for companions, he began the publication of his magnificent work. It was completed in London in 14 years, and his fame was established. 175 Subscribers, at 1000 dollars each, most of them obtained by himself in person, and 80 of whom were his own countrymen, remunerated his vast undertaking. He was made a Fellow of the Royal Society of London, published a Synopsis of his great work at Edinburgh, and finally, in 1839, returned home, bringing with him all his original drawings. He republished the work in New York, in royal 8vo, and, with Dr. Bachman, the eminent Zoologist, began another work, "The Quadrupeds of North America," which was completed in 1849. In speaking of these works, particularly the last, mention should be made of his two sons, whose accomplishments in Arts and Science have been so useful to their father. Audubon died Jan. 27, 1851.

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James Dwight Dana, Doctor of Law, Professor of Geology and Natural History in Yale College, Connecticut, United States of America, Corr. Member of the Royal Academy of Sciences in Prussia, of the Royal Academy of Sciences in Bavaria, of the Imperial Society of Naturalists at Moscow, of the Helvetic Society of Natural Sciences, of the Philomathic Society at Paris, of the Academy of Sciences at Liége, of the Geological Society at London, of the Linnæan Society at London, of the American Academy of Arts and Sciences at Boston, of the Academy of Natural Sciences at Philadelphia, of the Lyceum of Natural History at New York, &c.

Professor James D. Dana was born February 12, 1813, in Utica, Oneida County, State of New York, where he passed his early years.

In the autumn of 1830 he entered Yale College, in New Haven, Connecticut, attracted by the reputation of Professor Benjamin Silliman, sen., the distinguished Pioneer in American Science, whose lectures on Chemistry and Geology during more than half a century have added lustre to that ancient and celebrated institution of learning. During the regular course of study at New Haven, Mr. Dana evinced an especial love for the natural sciences, without neglecting philological and mathematical pursuits, in the latter of which he was distinguished. He was graduated with honour, Bachelor of Arts, in 1833, and about the same time received the appointment of Teacher of Mathematics to Midshipmen in the Navy of the United States. In that capacity he sailed to the Mediterranean, in the U. S. ship of the line "Delaware," returning in 1835. During the two years following he acted at Yale College as Assistant to the distinguished Professor whose successor in office he afterwards became.

In December, 1836, he was appointed Mineralogist and Geologist of the Exploring Expedition then about to be sent by the Government of the United States to the Southern and Pacific Oceans.

The five vessels of the squadron, under the command of Commodore Wilkes, sailed in August, 1838, on a voyage around the world. After extensive explorations, and suffering shipwreck moreover at the mouth of the Columbia River in Oregon, Mr. Dana returned home in June, 1842. The rare opportunities which this voyage afforded for scientific observation had been well improved. During the thirteen years after its termination, he was engaged in preparing for publication the various reports of this Expedition committed to his charge, and in pursuing other scientific labours.

He resided at Washington from 1842 to 1844, and then returned to New Haven, Connecticut, where he soon after married Henrietta Frances, third daughter of Professor Benjamin Silliman, and where he has since resided.

Before going to the Pacific he published, in 1837, the first edition of his Mineralogy, a work of high repute in Europe and America, of which the fourth and last edition appeared in 1854.

His first publication connected with his observations in the Exploring Expedition was a Report on Zoophytes, which appeared in 1846, a 4to volume of 740 pages, with an Atlas of 61 folio plates. In this work, Mr. Dana reviewed the whole department of Polyps, combining his own observations with those of earlier authors, and proposed a new classification, bringing, for the first time, the Actiniæ and the Alcyonoid Polyps into their true relations to the Astræoid Polyps. The number of new species which he describes is two hundred and thirty.

The second work in the same series was a Report on the Geology of the Pacific, published in 1849, a 4to vol. of 756 pages, with an Atlas of 21 Plates. This work presents a view not only of the geology of parts of Australia, Western America, and the islands of the Pacific, but also treats at length, and with original views, of Volcanic phenomena, Coral Reefs and Islands, and the General Features of the Globe.

The third work, pertaining to this Government Exploring Expedition, was a Report on Crustacea, which appeared in 1852-1854, the text 1620 pages 4to, the Atlas 96 Plates in folio. Six hundred and eighty species are described in this work, of which six hundred and fifty-eight are new. The subjects of Classification and Geographical Distribution receive in it special attention. These Reports were published by the Government of the United States, and only 200 copies of each have thus far been issued. With few exceptions, the drawings in these atlases were made by Mr. Dana himself.

While engaged in preparing the last two of these reports, Mr. Dana has been the active Editor of the American Journal of Science and Arts, founded in 1819, by Professor Silliman, sen., and well known as the great repository of the scientific labours of their countrymen. To this Journal which reached its seventy-third volume in 1857, as well as to the Proceedings of the American Academy of Arts and Sciences in Boston, the Lyceum of Natural History of New York, and the Academy of Natural Sciences of Philadelphia, Mr. Dana has contributed various important memoirs.

Soon after the resignation by Professor Silliman of the Chair of Chemistry and Geology in Yale College, Mr. Dana entered, in 1855, on the duties of the office of Silliman Professor of Natural History and Geology in that Institution, to which place he had been elected in 1850, his brother-in-law, Professor Benjamin Silliman, jun., having been appointed to the Chair of Chemistry. In discharging the duties of his professorship and in editing the American Journal of Science, Professor Dana is now engaged.

In 1854 he was elected President of the American Association for the Advancement of Science, having been for many years one of the Standing Committee of that body, and in August, 1855, he delivered the Annual Address before that Association at its meeting in Providence.

Professor Dana's contributions to science evince uncommon skill in observation and great industry, united to a high order of genius. They are probably unsurpassed in extent and value by those of any American philosopher.

The principal publications of Professor Dana are as follows:—

Treatise on Mineralogy, 1st edition, 8vo, pp. 572. New Haven, 1837. 2nd edition, 8vo, pp. 634, 1844. 3rd edition, 8vo, pp. 712, 1850. 4th edition, 2 vols. 8vo, pp. 320 and 554, 1854.

Manual of Mineralogy, 12mo, pp. 432. New Haven, 1851. 2nd edition, 1857.

Reports of the U. S. Exploring Expedition under Commander Wilkes—(published by the Government of the United States):—

- On Zoophytes. 4to, text pp. 740, Atlas, 61 plates folio. Washington and Philadelphia, 1846.
- On Geology. 4to, text pp. 756, Atlas, 21 plates folio. 1849.
- On Crustacea. 2 vols, 4to, pp. 1620. 1852-3. Atlas 96 plates folio. 1855.

On Coral Reefs and Islands. 8vo, pp. 144. New York, 1853.

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TITAN, *Nov.* 1857.

CONTENTS.

LETTER I.

INTRODUCTORY.

LETTER II.

OBJECTIONS ANSWERED.

That Entomology is a trifling pursuit.

That Entomologists confine themselves chiefly to nomenclature.

That it leads to cruelty.

LETTER III.

METAMORPHOSES OF INSECTS.

States of Insects (*egg*, *larva*, &c.)

(Orders of Insects.)

Theory of Metamorphoses.

Object of Metamorphoses.

LETTER IV.

DIRECT INJURIES CAUSED BY INSECTS. (AFFECTING MAN PERSONALLY.)

1. *Insects which make man their food.*

Pediculus humanus, &c.

Acari.

Larvæ.

Fleas.

Chigoes.

Harvest Bugs, Ticks, &c.

Bed Bugs, &c.

Insects giving an electrical shock.

Horse Flies, &c.

Mosquitoes, &c.

2. *Insects which attack man from revenge or fear.*

Bees, Wasps, &c.

Ants.

Scorpions.

Centipedes, Tarantula, &c.

3. *Insects simply annoying to man.*

Thrips, *Simulium*, &c.

House Fly.

Hairy Caterpillars, &c.

4. *Insects producing internal diseases.*

Beetles.

Caterpillars.

Gad-flies, &c.

Bees collecting poisonous honey.

LETTER V.

INDIRECT INJURIES CAUSED BY INSECTS.

1. *Injuries to our living animal property.*

To the Horse.

Ox.

Sheep.

Deer.

Dog.

Hive Bee, &c.

LETTER VI.

INDIRECT INJURIES—*continued.*

2. *Injuries to our living vegetable property.*

To Field Crops.

Wheat.

Wheat, &c., in granaries.

Rye, Barley.
Indian Corn, &c.
Peas, Beans, &c.
Clover Seed.
Pastures and Meadows.
Crops generally.
Hops.
Sugar.
Cotton, Tobacco, and Coffee.
Carrots.
Potatoes.
Turnips.
Beet.

To Garden Crops.
Kitchen Garden.
Radishes, Lettuces, &c.
Cabbages, Cauliflowers, &c.
Peas, Beans, Carrots, &c.
Flower Garden.
Stove and Greenhouse.

To Orchard and Fruitery.
Raspberries.
Gooseberries and Currants.
Cherries.
Plums.
Pears.
Apples.
Peaches and Nectarines.
Olives.
Chestnuts and Dates.
Pomegranates and Oranges.
Grapes.
Fruit Trees generally.

To Plantations and Groves.
By Beetles.
Caterpillars.
Aphides (honey-dew).
Insects attacking the interior of trees.
Insects attacking their bark and alburnum.

LETTER VII.

INDIRECT INJURIES—*continued.*

The ravages of Locusts.

LETTER VIII.

INDIRECT INJURIES—*concluded.*

3. *Injuries to our dead property, whether animal or vegetable.*

To our Food.
Drugs.
Clothes.
Houses and Furniture.
Timber.
Books, Pictures, &c.
Dead Stock generally.

LETTER IX.

INDIRECT BENEFITS DERIVED FROM INSECTS.

By maintaining a due balance between vegetable and animal productions.
removing nuisances and deformities.
destroying noxious Insects.
serving as food for other animals.
promoting the fertilisation of plants.

LETTER X.

DIRECT BENEFITS DERIVED FROM INSECTS.

As serving for the food of man.
As affording Medicines.
Dyes.
Wax.
Honey.
Silk.

LETTER XI.

AFFECTIONS OF INSECTS FOR THEIR YOUNG.

1. *Insects which perish before their young come into existence.*

Butterflies.
Ichneumons.

Sand Wasps, &c.
Wild Bees.
Beetles.

2. *Insects which attend their young when hatched.*

Mason Wasp.
Saw Fly.
Wood-boring Beetle.
Field Bug.
Earwigs.
Spiders.
Ants.
Wasps.
Bees.
Humble Bees.
Termites.

LETTER XII.

FOOD OF INSECTS.

Insects which feed on vegetables.
animals.
both vegetables and animals.
Time of feeding.
Instruments of nutrition.
Proportion of food consumed.
Power of abstinence.

LETTER XIII.

FOOD OF INSECTS—*continued.*

Stratagems employed in procuring it.

Threads of Spiders.
Webs of House Spiders, &c.
Nets of Geometric Spiders.
Renewal of Geometric nets.
Other Spiders' webs.
Spiders which do not form webs or nets.
Diving Spider.
Ant Lion.
Leptis Vermileo.

LETTER XIV.

HABITATIONS OF INSECTS.

1. *Of solitary insects forming them for their young.*

Clothier Bees.
Carpenter Bees.
Mason Bees.
Upholsterer Bees.
Leaf-cutting Bees.
Mason Wasp.
Leaf-rolling Weevils.
Gall Flies.

2. *Of solitary insects forming them for their own use.*

In the interior of leaves.
Of leaves cut off and rolled up.
Silk.
Lichen, Stone, &c.
Grass, Bark, &c. (*Psyche*).
Gummy cement (*Clythra*).
Wax (*Galleria*).
Wool or Hair (Caterpillars of Clothes-Moths).
Cotton.
Grass, Rushes, Sand, &c. (Caddis-worms).
Earth and Silk with a trap door (Spiders).
Air (Diving Spider).

LETTER XV.

HABITATIONS OF INSECTS—*continued.*

3. *Of insects living in society.*

Caterpillars.
Ants.
Hive Bees.
Humble Bees.
Wasps.
Termites.

LETTER XVI.

SOCIETIES OF INSECTS.

1. *Imperfect societies.*

Associations for company.
of males.
for emigrating.
of Caterpillars.
Aphides.
Lady-birds.
Turnip Saw-flies.
Dragon-flies.
Frog-hoppers.
Beetles.
Butterflies.
Field Bugs.
Locusts.
for mutual assistance.
Ateuchus pilularius.
Caterpillars.

LETTER XVII.

SOCIETIES OF INSECTS—*continued.*

2. *Perfect societies (White Ants and Ants).*

White Ants.

Individuals composing the society.
Establishment of colonies.
Building and repairing habitations.
Collecting food.
Defence of habitations.
Termes lucifugus.

Ants.

Storing up food.
(Gould's "English Ants.")
Individuals composing the society.
Formation of new societies—Winged Ants.
Language.
Affections and aversions.
Formic acid.
Wars.
Slave-making.
Milch Cattle—Aphides, &c.
Emigrations.
Working all night.
Roads and track-ways.
Strength and perseverance.
Bridge-making.
Repose and sleep.
Sports and games.

LETTER XVIII.

PERFECT SOCIETIES OF INSECTS—*continued.*

Wasps.—Humble Bees.

Wasps.

Individuals composing the society.
Labours of workers.
Storing up honey.
Sentinels.

Humble Bees.

Individuals composing the society.
Employment of females.
Small females.
Parasitic Humble Bees.
Temper and disposition.

LETTER XIX.

PERFECT SOCIETIES OF INSECTS—*continued.*

Hive Bee.

Individuals composing the society.
Education of a new Queen.
Larvæ and pupæ.
Queen Bee.
Combats of Queens.
First swarm conducted by the old Queen.
Treatment of young Queens.
Devotion to the Queen.

Loss of a Queen.
Fecundation of the Queen.
Oviposition by the Queen.
Swarming.

LETTER XX.

PERFECT SOCIETIES OF INSECTS—*concluded.*

Hive Bee.

Drones.
Workers.
collecting nectar.
pollen.
propolis.
Distance of excursions.
Scouts.
Population of a hive.
Transportation of hives.
Ventilation.
Cleanliness.
Language.
Anger.
Wars.
Enemies.
Accidents.
Temperature of the hive.
Instincts not mere sensations.

LETTER XXI.

MEANS BY WHICH INSECTS DEFEND THEMSELVES.

1. *Passive.*

By imitating various substances, objects, and colours.
their brilliant colours.
frightful aspect, horns, &c.
spines, hairs, &c.
hardness and toughness.
involuntary offensive secretions.
power of vitality.
extraordinary multiplication.

2. *Active.*

By rolling themselves into a ball.
simulating death.
assuming various attitudes.
motions to alarm or escape their enemies.
noises.
disgusting and powerful scents.
scent-organs.
explosive discharges.
emission of repulsive fluids.
their weapons of defence.
concealing themselves.
feeding only by night.
especial modes of defence.

LETTER XXII.

MOTIONS OF INSECTS.

Larva and Pupa.

1. Of *Larvæ.*

Destitute of proper legs.
Provided with proper legs.
Residing in water.

2. Of *Pupæ.*

LETTER XXIII.

MOTIONS OF INSECTS—*continued.*

Imago.

1. *While in repose.*
2. *While in action.*

Walking.
Running.
Jumping.
Climbing.
Flying.
without wings (Spiders).
with wings.
Beetles.
Earwigs.
Stylops, &c.
Grasshoppers, &c.

Field Bugs, &c.
May-flies, &c.
Butterflies and Moths.
Bees, Wasps, &c.
Flies, &c.

Swimming.
Walking in or on water.
Burrowing.
Hovering.
Gyrations.
Dancing.

LETTER XXIV.

Noises produced by Insects.

While in motion.
While feeding, &c.
In calling, commanding, or giving an alarm.
As expressive of fear, anger, sorrow, love, &c.

By Beetles.
Field Bugs.
Moths.
Bees, &c.
Grasshopper tribe.
Crickets.
Locusts, &c.
Cicadæ, &c.

LETTER XXV.

Luminous Insects.

Glow-worms.
Fire-flies.
Other Luminous Beetles.
Lantern-flies.
Other Luminous insects.
Source of their luminous property.
Its remote cause.
Its use.

LETTER XXVI.

Hybernation of Insects.

In the egg state.
pupa state.
larva state.
perfect state.
Time of hybernation.
Site of Hybernacula.
Solitary and social hybernation.
Hybernation in several states.
Torpidity produced by cold.
Variations of torpidity.
Some insects never torpid.
State of the Hive Bee in winter.
Power of resisting cold by insects in different states.
Cause of this power.
Resumption of activity.
Cause of hybernation.

LETTER XXVII.

Instinct of Insects.

Nature of instinct.
Definition of instinct.
Exquisiteness of the instincts of Insects.
Variations of instinct.
Variations of instinct in the Hive Bee.
These variations not the result of reason.
Number of instincts in Insects.
Extraordinary development of instinct in Insects.
Reason in Insects.
Insects gain knowledge from experience.
receive and communicate information.
are endowed with memory.

Appendix.

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